HAWKE'S BAY
REGIONAL COUNCIL
TE KAUNIHERA Ā-ROHE O TE MATAU-A-MĀUI

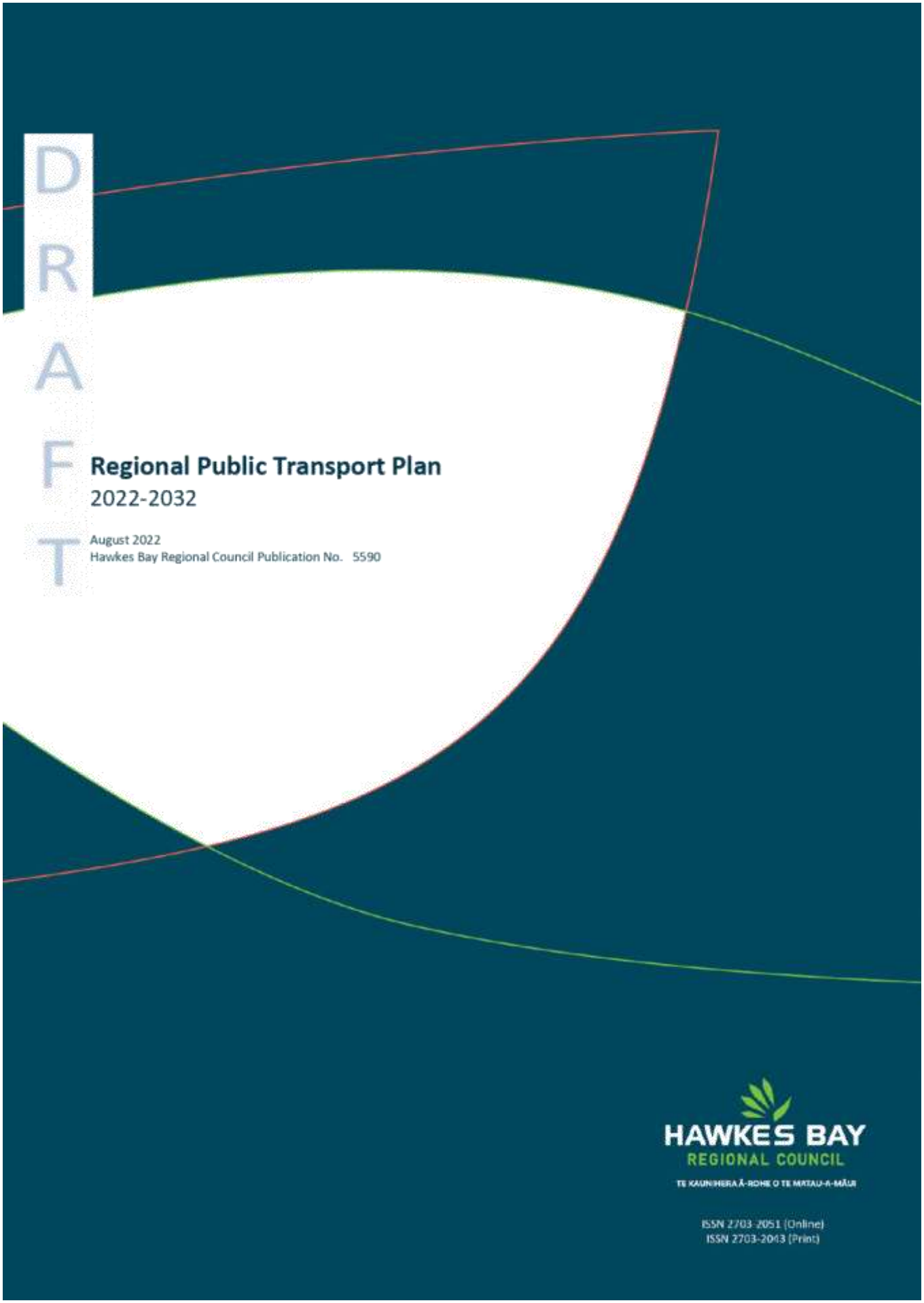
Meeting of the Hawke's Bay Regional Council

Date: Wednesday 28 September 2022

Time: 11.00am

Venue: Council Chamber
Hawke's Bay Regional Council
159 Dalton Street
NAPIER

Attachments Excluded From Agenda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Regional Public Transport Plan
2022-2032
August 2022
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Transport Planning

Regional Public Transport Plan
2022-2032

August 2022
Hawkes Bay Regional Council Publication No. 5590

Prepared By:
MRCagney (NZ) Ltd

Reviewed By:
Katie Nimon – Manager – Transport

Approved By:
Katrina Brunton – Group Manager – Policy and Regulation

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1 Introduction

1.1 About the Regional Public Transport Plan

The Hawke's Bay Regional Public Transport Plan (RPTP), prepared by the Hawkes Bay Regional Council (HBRC), is a strategic document that sets the objectives and policies for public transport, contains details of the public transport network and development plans for the next ten years.

The RPTP provides a means for councils, transport operators, stakeholders, and the public to work together to develop and improve the public transport network and supporting infrastructure.

Hawke's Bay Regional Council (HBRC) is responsible for providing public transport services in our region, which largely comprise bus services that operate in and between Napier and Hastings, and the Total Mobility service, which provides discounted transport for people with disabilities which prevent them from using buses. These services are provided under contract to, and are subsidised by, HBRC.

The money to pay for these contracts comes from fares from passengers using the service, Waka Kotahi NZ Transport Agency and HBRC ratepayers.

1.2 Timeframe

This RPTP covers the ten-year period from 2022 to 2032 but must be reviewed in three years' time. However, the Plan may also be reviewed in the event of any major changes to the funding or planning environment.

1.3 Strategic context for the RPTP

1.3.1 The Land Transport Management Act 2003

The Land Transport Management Act 2003 (LTMA) was amended in 2013, repealing the Public Transport Management Act and bringing the relevant provisions into the LTMA. The amendments also legislated a new public transport operating model (PTOM) - a new framework for the planning, procurement and delivery of public transport services. There is a strong emphasis on early engagement and collaboration between regional councils, territorial authorities, and public transport operators.

The purpose of the LTMA is to "contribute to an effective, efficient and safe land transport system in the public interest" and requires regional councils to adopt a regional public transport plan (RPTP), which must be reviewed every three years. The LTMA prescribes how plans are to be developed and sets out the matters that must be contained in a plan. It also describes the purpose of the plan, which is to:

- describe the public transport services that are integral to the public transport network
- define the policies and procedures that apply to those public transport services
- identify the information and infrastructure that supports public transport

Principles of the Public Transport Operating Model (PTOM) have been incorporated into the LTMA. PTOM is a system for planning, procuring, and funding public transport. It aims to increase patronage with less reliance on public subsidies, through better collaboration between operators and regional councils. PTOM requires all bus services to be divided into units and provided under exclusive contracts to HBRC.

1.3.2 The Government Policy Statement on Land Transport

The Government Policy Statement on Land Transport sets out the Government's desired outcomes and priorities for the land transport sector, and broad funding allocations over the next decade. The 2021 GPS strategic priorities are:

- Safety
- Better travel options
- Improving freight connections

- Climate change

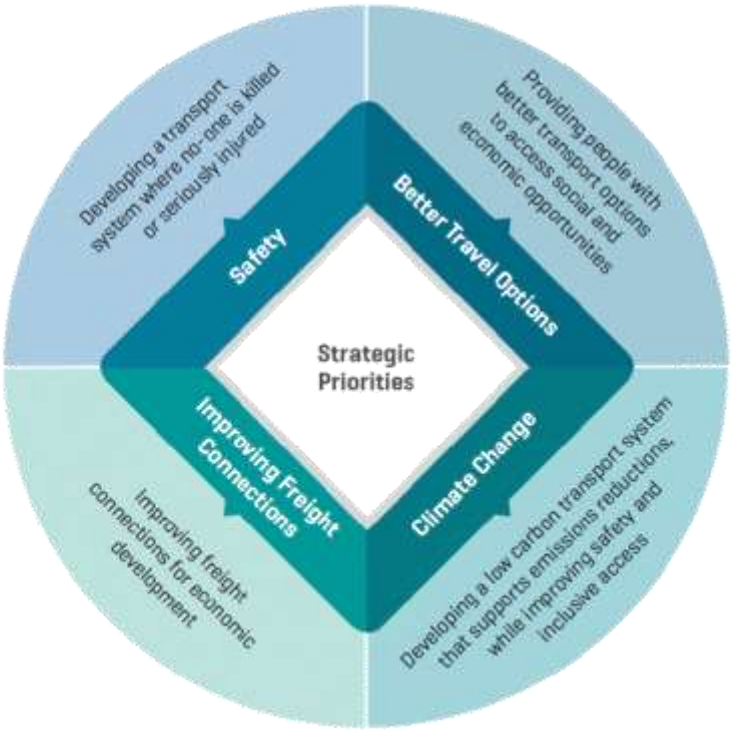

Figure 1: The four strategic priorities of the GPS-LT 2021

The Hawke's Bay RPTP has taken account of the 2021 GPS direction and priorities, particularly in relation to developing better travel options and climate change, through creating a path for "step change" in public transport for Hawke's Bay.

The RPTP contains the following direction that is consistent with the GPS:

- Investments in increased frequency and span of public transport services to meet the objective of better travel options
- Supports emission reductions and the climate change objective by creating viable alternatives to driving, further supporting vehicle kilometre travelled reduction targets.

1.3.3 The Regional Land Transport Plan

The Regional Land Transport Plan (RLTP) sets out the region's vision, objectives and funding for all modes of land transport for which funding is received from the National Land Transport Fund. It contains objectives relevant to public transport and also sets out the required funding for the provision of public transport services and infrastructure over the next three years.

The RLTP has the following vision:

"Hawke's Bay's transport network fosters a vibrant, accessible and sustainable carbon neutral Hawke's Bay."

Supporting strategic objectives include:

- Achieve a safe transport system for users.
- Achieve a transport network that is resilient, reliable, and efficient.

- Provide transport choices to meet social, environmental, and cultural needs.
- Develop a transport system that contributes to a carbon neutral Hawkes Bay
- Minimise travel demand through planning and development.

1.3.4 Hawke's Bay Regional Council Plans

The HBRC Strategic Plan 2020-25 identifies four areas of focus for this period. One of these is for sustainable and climate resilient services and infrastructure. The plan sets a strategic goal of a carbon neutral Hawke's Bay by 2050 to align with central government. The public transport services described in this RPTP will contribute to this goal.
The HBRC Long Term Plan sets out public transport activities and funding sources for the next ten years. The plan is reviewed every three years, but significant changes in activities or expenditure are captured in an annual plan.

1.4 Strategic Case

This section provides a summary of the strategic case for the Regional Public Transport Plan. The strategic case forms part of the business case approach to investment in transport. As part of this process, key stakeholders in public transport have jointly identified regional problems, the benefits of addressing those problems, and responses to them, considering the feedback received from consultation with bus users and stakeholder organisations.

Problem 1: Driving (Vehicle Kilometres Travelled) has been increasing in Hawke's Bay over the last decade. This is inconsistent with national and regional targets to reduce emissions from transport.
There are many incentives to drive in Hawke's Bay. There is little congestion due to historical investment in high-capacity roads. Parking in both cities is plentiful and cheap. There is plenty of all-day free parking within easy walking distance of the city centres, and district plan rules have required parking provision for businesses until recent changes in 2022.
This environment has supported increases in Vehicle Kilometres Travelled (VKT) over the past decade. This is inconsistent with the national goal of reducing VKT by 20% of 2019 levels by 2035 from the first Emissions Reduction Plan (ERP) 2022. As Napier-Hastings is a Tier 2 urban area, it will be required to develop a regional VKT reduction plan for light vehicles. Figure 2 shows the VKT trend in Hawke's Bay between 2001 and 2020.

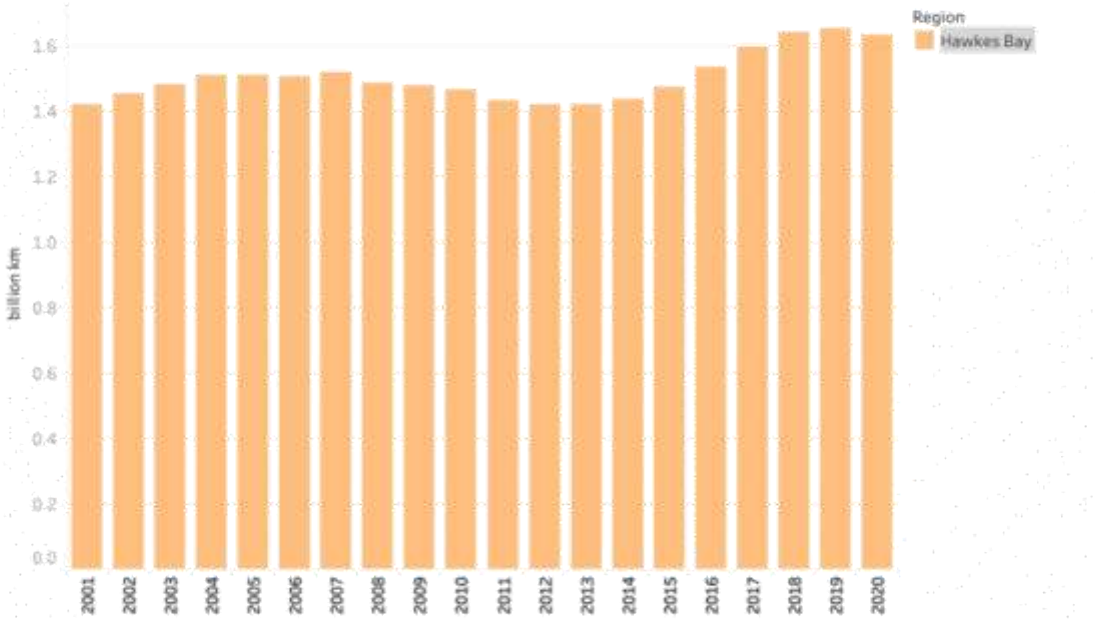

Figure 2: Vehicle Kilometres Travelled in the Hawke's Bay – Source Ministry of Transport

This RPTP is responding to this policy direction ahead of time, by developing a plan for public transport that is a viable and attractive alternative to driving for more journeys. This will support a reduction in driving in the Napier-Hastings urban area.

Problem 2: The current car focused investment model in both rural and urban areas is leading to a suboptimal transport system that does not effectively integrate public transport and is inequitable for those who cannot drive.

Over recent decades, transport planning and investment has been targeted at providing an ever-improving roading network, with public transport filling a secondary role. The urban areas have grown almost entirely with low density, car-centric, suburban development at the fringe of the cities. This has contributed to the declining use of the public transport network and growth in driving.

A focus on roading improvements and car-centric development excludes those who are unable to drive, whether due to age restrictions, disability, or the cost of driving. It is therefore an inequitable distribution of resources.

Population growth is forecast to occur in Central Hawke's Bay towns like Waipukurau and Waipawa. While this provides significant opportunities, it needs to be supported with investments in public transport. This is necessary to mitigate the impact of this growth on vehicle kilometres travelled, as well as ensuring more equitable access to the services and opportunities located in Hastings and Napier.

Wairoa currently has no public transport services, leaving the community with few options. While traditional public transport may not be well suited to a small community, there is a desire to see alternative services introduced.

Problem 3: Public transport is not seen as an attractive or viable alternative to driving, in part due to limited frequency, span and accessibility of the existing network.

Public transport in the region is often viewed as a mode used only by people without any alternative. In the absence of significant deterrents to driving like traffic congestion or parking pressures, many Hawke's Bay residents simply do not think public transport is for them. The convenience of driving often outweighs any

other reasons for using public transport. This view supports the limited historical investment in public transport, further embedding public transport as an option only for those with no other choice.
The current public transport network uses several low-frequency one-way loop routes to provide high coverage from a limited budget, however this results in poor service levels across the network. The existing network runs at low frequencies for limited hours each day. Most services are hourly or half hourly, even at peak times, with the last buses commencing service just after 6pm on weekdays, while weekend service is even more limited. This makes it inconvenient and unattractive for most potential users, which does not help reverse falling patronage.
Strategic Response The strategic responses we have developed to address these issues are described in Section 6.

2 Background

2.1 Current services

The current bus and other services supported by HBRC are broadly described below. Details of the services HBRC considers to be integral to the public transport network in Hawke's Bay for the life of this RPTP are described in more detail in Appendix A.

2.1.1 Bus services

HBRC currently contracts the provision of bus services in and between Napier and Hastings. This contract, which expires in July 2025, includes the following services:

- Between Napier and Hastings via Taradale and the Eastern Institute of Technology
- The Express between Napier, Hastings, and Havelock North (via Clive)
- The Express between Napier and Hastings via the Hawke's Bay Expressway
- Between Havelock North and Hastings
- Between Flaxmere and Hastings
- Within Hastings (covering the suburbs of Camberley, Mahora, Parkvale and Akina)
- Within Napier (covering the suburbs of Tamatea, Taradale, Maraenui, Onekawa, Ahuriri, Westshore and Bayview).

2.1.2 Other services

'MyWay' On-demand trial

In June 2022, HBRC started a trial of on demand transport in suburban Hastings, replacing the underperforming 16A, 16B and 17 routes. On demand allows users to book a ride through a call centre or app and be collected from a 'virtual stop' nearby and dropped off close to their destination. The trial will allow HBRC to test and understand the potential role of on-demand within the Hawke's Bay public transport system and gauge community response to a more frequent and reliable public transport service.

Total Mobility Scheme

HBRC funds and manages the Total Mobility scheme in Hawke's Bay. Total Mobility is a nationwide scheme which provides subsidised (half price, up to a maximum subsidy of $40 per trip) taxi travel for people of all abilities who are unable to make use of the public transport network. The scheme also funds the provision of hoists for vehicles capable of carrying people who are use mobility aids. The scheme operates in Napier, Hastings, and Central Hawke's Bay. The Total Mobility Scheme is now managed via the national Ridewise platform, removing the reliance on members requesting pink voucher books to access the subsidy.
While the Total Mobility Scheme is important for providing more equitable access for those who cannot drive and even with the 50% subsidy on taxi travel, it is not an affordable or equitable for everyone for all trips. Creating an attractive and accessible public transport network that can suit the need of more people is key to managing demand for Total Mobility subsidies and delivering more equitable access.

SuperGold Card free travel scheme

This is a nationwide scheme, which provides free off-peak travel (between 9am and 3pm on weekdays and anytime on Saturday, Sunday and public holidays) on all local buses for SuperGold Card holders. The scheme is funded by central government and administered by HBRC.

2.1.3 Service improvements

HBRC has made many service and infrastructure improvements to bus services over the past few years. These improvements are listed below. Since 2009 the following improvements have been made by HBRC to bus services in Hawke's Bay:

Table 1: Service improvements made to the Hawke's Bay network since 2011

Service	Route	Improvements
10 EXPRESS	Between Napier and Hastings via the Expressway	• New service introduced in September 2008 (cancelled in May 2014 due to low patronage, re-introduced in September 2016 on a different route to coincide with the HBDHB's Workplace Travel Plan).
11 EXPRESS	Between Havelock North and Napier, via Hastings and Clive.	• New service introduced in September 2008.
12N	Napier to Hastings, via Taradale, EIT, Hawke's Bay Hospital and Bay Plaza	• Introduced an extra 2.30pm service Monday to Friday in November 2009. • Increased the number of Saturday services in November 2009 from 5 to 11. • Introduced a new Sunday service in January 2011. • Increased services to operate every 20 minutes in peak times and every 30 minutes in off-peak times.
12H	Hastings to Napier, via, K-Mart, Hawke's Bay Hospital, EIT and Taradale.	• Introduced an extra 2.30pm service Monday to Friday in November 2009. • Increased the number of Saturday services from 5 to 11 in November 2009. • Introduced a new Sunday service in January 2011. • Increased services to operate every 20 minutes in peak times and every 30 minutes in off-peak times.
13	Napier-Tamatea-Taradale-Tamatea - Napier	• Route extended to include Taradale shopping centre in November 2009. • Increased the number of services, Monday to Friday, from 9 to 11, in January 2011. • Introduced a new Saturday service in January 2011. • Route extended to cover Summerset Retirement Village, five trips Monday to Friday in 2017
14	Napier-Maraenui-Onekawa-Napier	• Changed Saturday services to provide coverage from 5 hours to 7 hours in January 2011.

Service	Route	Improvements
15	Napier-Ahuriri-Westshore-Ahuriri - Napier	• Trial made permanent in September 2012, operates Monday to Saturday. • Route extended to cover Bay View, five trips Monday to Friday and all four Saturday trips, in 2016.
16 A & B	Hastings-Camberley-Raureka-Hastings Hastings-Mahora-Hastings	• Added an extra service at the end of the day, Monday to Friday, in November 2009. • Replaced with MyWay on-demand as part trial in June 2022.
17	Hastings-Parkvale-Akina-Hastings	• Changed route to travel via Summerset Retirement Village in November 2012. • Extended service coverage from 8 hours to 10 hours in 2016. • Changed route to travel via Karamu High School in 2016. • Replaced with MyWay on-demand as part of trial in June 2022.
20	Hastings-Flaxmere-Hastings, via The Park, Hastings	• Added an extra service at the end of the day, Monday to Friday, in November 2009. • Added an extra service in the middle of the day, Monday to Friday in January 2011. • Extended Saturday service coverage from 6 hours to 9 hours in January 2011. • Added seven extra daily services, Monday to Friday, in October 2012.
21	Hastings-Havelock North-Hastings, via The Park, Hastings	• Added an extra service in the middle of the day in January 2011 • Extended the route of the Saturday service to follow the same (wider) route as the Monday to Friday service in January 2011. • Introduced a Sunday service, consisting of 3 trips, in 2016. • Extended the route to cover the Summerset Village on Arataki Road and to better service the Lipscombe Crescent area.
MyWay On-demand	Hastings Urban Area	• On-demand trial for Hastings urban area, excluding Flaxmere and Havelock North, replaces routes 16 A & B and 17 in June 2022.
BUSES	All routes	• All buses (with the exception of the Express services) wheelchair accessible from 2009. • All buses meet the Euro 4 emission standard. • Introduced Public Holiday services (Saturday/Sunday timetable applies) in October 2011. • Bike racks installed on most of the fleet in October 2012. • Bike racks available on all the buses from 2016.

Service	Route	Improvements
		• All buses wheelchair accessible from 2016.
TICKETING	All routes	• Introduced a "Smartcard" fare payment system in 2009. • New Bee Card integrated ticketing introduced in August 2020.
FARES	All routes	• Simplified the fare structure by reducing the number of fare zones from four to two in November 2009. • Introduced a new concessionary fare category – 'Community Services Cardholders' to replace the 'beneficiary' and 'disabled' categories, in June 2010. • Set up system whereby passengers and caregivers travelling from Napier to Hawke's Bay Hospital for appointments/treatment can travel free of charge, with fares reimbursed by the Hawke's Bay District Health Board. • Fares are reviewed annually each September (though not necessarily increased). • Work with NGOs and government agencies to provide bespoke ticketing arrangements. • Free travel for hospital patients extended to passengers travelling to both Napier and Hastings for medical appointments (fares reimbursed by the HBDHB) in 2017. • Workplace travel plan arrangement established with the HBDHB (fares subsidised by the HBDHB) in 2017. • Trial of 'flat fares' approach, with $1 for one zone and $2 for two zones with a Bee Card began in August 2020.

The number of bus passengers increased significantly between 2009 and 2014 but has declined since then, dropping back to 2009 levels before suffering further losses during the Covid-19 pandemic (refer Figure 3 below).

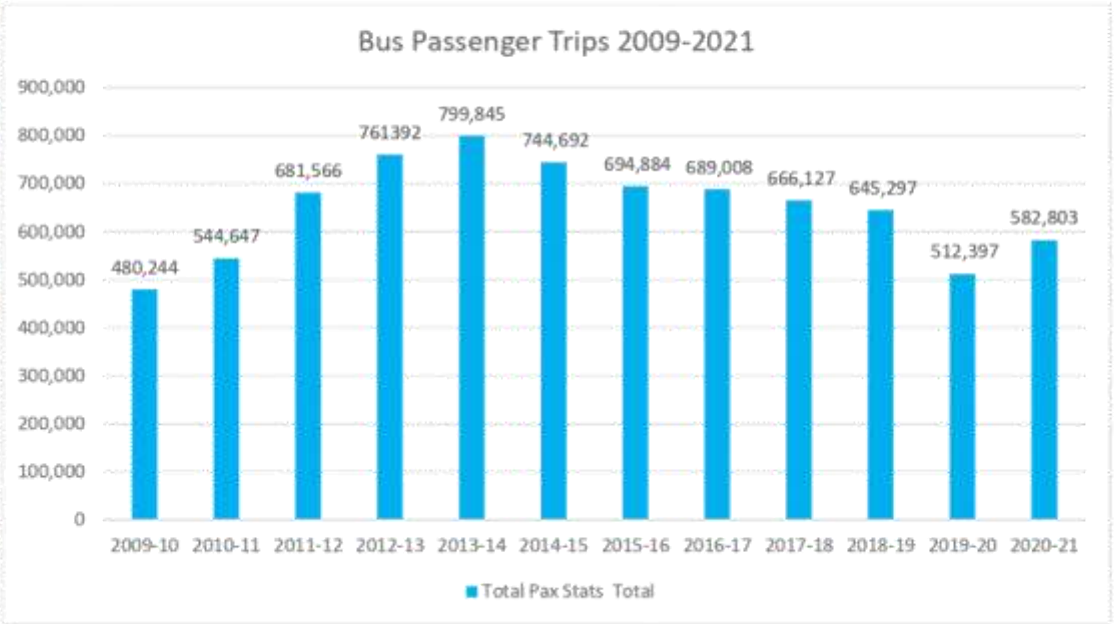

Figure 3: Hawke's Bay bus passenger trips by year

2.1.4 Total Mobility Scheme

The Total Mobility Scheme is a nationwide scheme that provides discounted taxi transport for people with disabilities which prevent them from using public transport. Eligibility for the scheme is determined by the effect the impairment has on the individual's ability to undertake components of a journey on the public transport network.

Total Mobility services are provided under contract to, and are subsidised by, HBRC.

The use of the Total Mobility Scheme has generally increased over the past decade due to an aging population. In 2022 there are 3,521 members, compared to 3,598 in 2017-18, 1,914 in 2008-09 and 2,640 in 2011-12. As demonstrated in Figure 4 below, Total Mobility trips were trending upwards prior to 2020, in which trips were down, likely due to Covid-19. Given Hawke's Bay's population is ageing, the upwards trend is likely to re-establish as a sense of normality returns post pandemic.

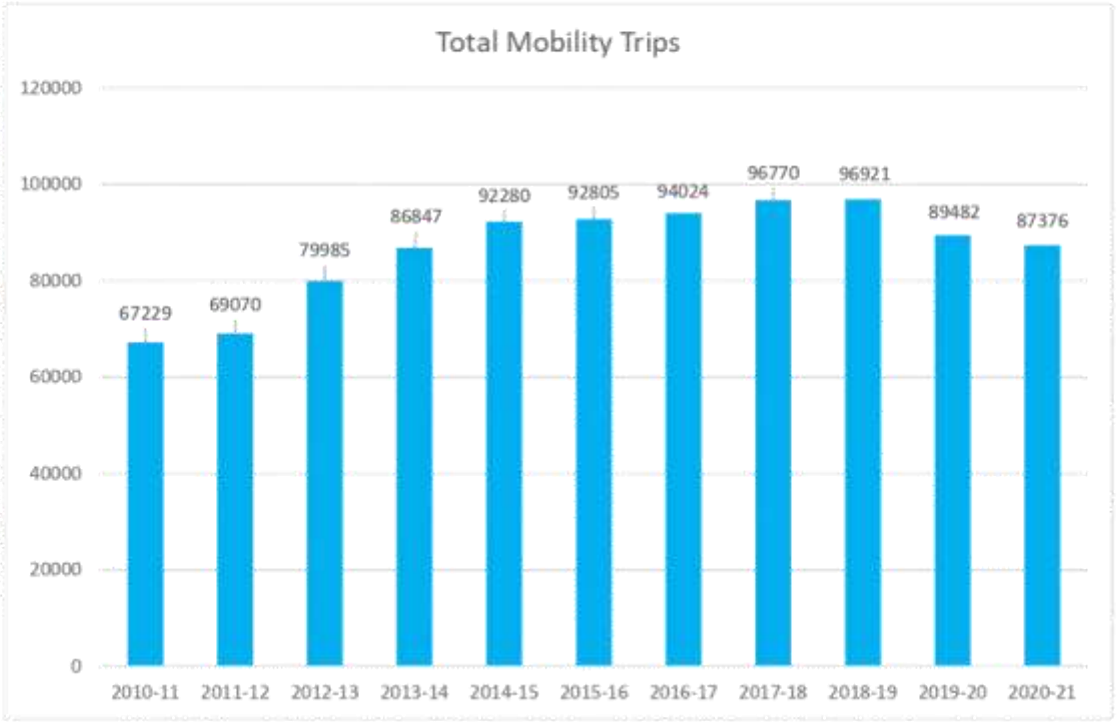

Figure 4: Hawke's Bay total mobility passenger trips

2.2 Why HBRC subsidises public transport

Passengers do not pay the full cost of the public transport services they use. Passengers' fares covered 19% of the cost of running the bus services In Hawke's Bay in 2020-21, a historically low level as patronage and fare revenue was significantly impacted by Covid-19 restrictions. HBRC aims to increase the farebox recovery ratio back to the pre-pandemic rate of 37%. Total Mobility passengers pay half the cost of their travel.

HBRC and the Waka Kotahi NZ Transport Agency subsidise public transport because it provides a range of benefits.

Roading and parking: Public transport helps relieve road congestion and reduce the need for new roads. It also reduces pressure on car-parking spaces.

Economic: Providing people with access to employment and educational facilities results in economic benefits for the individual and the community. There are also economic benefits from the reduced need for road construction and maintenance.

Environmental: Buses save energy compared to car trips and result in reductions in vehicle exhaust and noise emissions. Modern buses are extremely fuel efficient and have low emissions.

Health: Public transport has benefits to health, as most journeys involve a walk or bike ride to and from the bus stop and result in fewer emissions and airborne particulates than driving. It may also prove less stressful than driving.

Access and mobility: Public transport provides a means of travel to work, education, and public services for those who may not have alternative transport options. It is an essential link for many between residential areas, commercial areas, recreational areas, educational facilities, health services and community events and activities.

Safety: People have a much lower risk of accidental injury on a bus than using any other mode of transport.
Social: Many people do not have access to a car, with public transport the only viable option for travel. There is a significant social benefit from reducing community isolation.
Community resilience: A strong public transport network provides transport resilience in the face of rising/unpredictable fuel prices.

2.3 Involvement of other parties

There are many parties involved with providing public transport services. While HBRC plans, funds, and contracts the required services, other parties also have a role to play.
The territorial authorities (in particular Napier City Council and Hastings District Council) play a major role through the provision of supporting infrastructure such as bus-stops. The NZ Transport Agency provides substantial funding for public transport.
The District Health Board funds the provision of free trips for hospital patients on all services and provides incentives to encourage its staff to use the bus. Community organisations also have a role to play as advocates for the needs of the users.
Under PTOM, service providers are critical partners. HBRC works with its service operators in a spirit of collaboration in order to improve the efficiency and effectiveness of services. Practices such as annual business planning, and financial incentive mechanisms will encourage all parties to work together to plan, innovate and improve public transport in Hawke's Bay.
This Plan cannot be successfully implemented without the support of all these parties. HBRC will work closely with these parties to facilitate the provision of the required services.

2.4 Funding

The funding for the services in this Plan comes from three sources:

- Fare revenue from passengers, organisations which purchase tickets on behalf of their members and a crown appropriation (through the Ministry of Transport but administered by the Waka Kotahi NZ Transport Agency), which pays for the cost of free off-peak travel for SuperGold card holders. From September 2022, there will be a 50% discount on adult fares for Community Services Card holders, paid for by Ministry of Transport in a similar manner to the SuperGold card scheme.
- HBRC, which raises its funds from local ratepayers via a targeted rate; and
- Waka Kotahi NZTA, which contributes between 50% and 60% of the cost of services after fares.

The Covid-19 pandemic has had a significant impact on patronage and fare revenue. Given the imperative to improve services to support mode shift, reduction in VKT and more equitable access by public transport, which requires increased funding, this Plan is being prepared with the assumption that increased funding and new sources can be identified in the lead up to the new 'step change' network implementation in 2025.
While there has been a decrease in fare revenue, this plan has been developed with the goal of being implemented within the currently indicated rates rise and spending over the coming decade, alongside the usual Waka Kotahi NZTA funding share.
It is expected the 'step change' network, detailed in Section 5, to be implemented in 2025 will deliver a significant increase in patronage and therefore fare revenue. The improved services will provide increased commercial opportunities including employer partnerships and advertising.
The changes to national funding policy in mid-2018 mean HBRC are no longer required to set a regional target for farebox recovery. However, monitoring of farebox recovery rates using the methodology and reporting process specified by Waka Kotahi is still required. This monitoring is detailed in Appendix D.
The farebox recovery ratio for Hawke's Bay bus services for the 2020/21 financial year was 19%. This reflects the disruption caused the Covid-19 pandemic with less people travelling decreasing patronage. While there is no requirement to set a target, HBRC considers it to be important to return this rate to

around pre-covid levels as soon as possible. The following strategies along with the strategic response, detailed in Section 5, will support this.

Strategy 1: Shift to a patronage focused network

The current network is coverage-focused by design with low frequencies and indirect one-way loops, limiting its ability to be viable and attractive alternative to driving. The low patronage from this leads to a low farebox recovery rate. The new network is patronage-focused by design, with high frequencies and direct bidirectional routes aimed at maximising ridership, which should lead to higher fare revenue and higher farebox recovery.

Strategy 2: Review of fare products and fare levels

Increasing fares can lead to increases in revenue and thus improve farebox recovery. Small increases in fares are likely to be required occasionally to cover the increases in costs of providing bus services. However, steep increases in fares can be inequitable and lead to loss in patronage, potentially resulting a net loss in fare revenue and worsened farebox recovery, so changes need to be well considered.
From September 2020, Waka Kotahi, on behalf of the Ministry of Transport, will fund half price fares for Community Service Card holders. This will open possibility for fare reviews and changes which can occur in an equitable manner while ensuring fares make a significant contribution to the cost of running the network, while achieving other council goals.

3 The Transport Disadvantaged

Under Section 120(1) (viii) of the LTMA, the draft Plan is required to describe how the proposed services will assist people who are "transport disadvantaged". Section 124(d) also requires HBRC to consider the needs of the transport disadvantaged when approving an RPTP.
The term "transport disadvantaged" is defined in the LTMA as those who HBRC has reasonable grounds to believe are the least able to travel to basic community activities such as work, education, health care, welfare, and shopping. HBRC believes the following groups are transport disadvantaged:

- Children
- The elderly
- People with disabilities
- Tertiary students
- People on low incomes
- People who are unable to drive or have no access to a vehicle

HBRC believes that the network changes, service improvements and the associated fare policies proposed in this Plan will assist the needs of these groups. The services proposed in the Plan are designed to provide wide coverage of residential areas, linking them with commercial and community facilities. By delivering a more legible, frequent network which operates for longer hours throughout the day and on weekends, the transport disadvantaged will be able to make more types of trips.
The existing fare system provides support to the elderly, who benefit from the SuperGold Card free travel scheme. From September 2022, there will also be a 50% discount on fares for Community Services Card holders.

The buses used on the services in Hawke's Bay are all wheelchair accessible, which assists people with disabilities, older people, and parents with young children. All buses have bike racks, which enables people to travel a greater distance to or from a bus stop, while electric scooters and other small micro-mobility devices can be carried onto buses. Bike racks on buses can only carry two at any one time. Improving bike parking at key bus stops and interchange points, can support greater use of bikes for first/last mile access. The Total Mobility Scheme provides services for those of all abilities who are unable to use public transport, however the Public Transport network infrastructure needs to become more accessible to enable people of all abilities to have equitable access and options.

HBRC continues to partner with a range of groups representing those who are transport disadvantaged, to ensure all needs are considered, and access remains equitable.

4 Vision, Objectives and Policies

4.1 Vision

HBRC's vision for public transport is:
"To deliver a public transport that is safe, accessible, and supports the shift to reduce driving and emissions in Hawke's Bay, while improving the economic, social, and environmental well-being of the people of Hawke's Bay."

4.2 Objectives and policies for Hawke's Bay Regional Council Bus Services

4.2.1 Our network:

Network design objectives

- A straightforward public transport network that runs all-day, seven days a week, with a hierarchy of routes at consistent levels of service.
- An effective network that connects residential neighbourhoods to key employment, shopping, medical, entertainment, recreational and educational facilities, and other destinations to serve more types of journeys.
- An efficient network that gets good value for money, by supporting the greatest number of journeys it can from the resources used to operate it.

Network operation and service quality objectives

- Bus schedules are frequent or run to a regular timetable to minimise waiting time and allow people flexibility for when they travel.
- Bus routes are direct, clear, and legible to be easy to understand and use.
- Services run right across the day to be available for people to use whenever they want to travel.
- Buses are timely and reliable to create an attractive service that users can rely on.

4.2.2 Our customers

Objectives:

- People in the urban areas of Hastings and Napier have access to public transport services to connect them to employment, shopping, medical, entertainment, recreational and educational facilities.
- Services are environmentally responsible and integrated with other transport modes, particularly walking, and cycling.

Table 2: HBRC customer policies

Policy Area	Policy
NETWORK DESIGN	HBRC will: 1. Plan and deliver a network which is simple and legible for users and reasonably direct. 2. Plan and procure services at the following minimum service levels for the core network of service • Frequent: 15 minutes or better between 7am and 7pm, 7 days (weekdays and weekends). Services may have lower frequency outside those hours. • Connector: 30 minutes or better between 7am and 7pm, 7 days (weekdays and weekends). Services may have reduced frequency outside those hours.

Policy Area	Policy
	• Other (Local, rural-township, peak-only, school, Total Mobility and on demand services): no minimum service levels. 3. Complete the MyWay on-demand trial and identify the role of on-demand in an integrated Hawke's Bay public transport network, complimentary to a fixed route network.
ACCESS TO SERVICES	HBRC will: 4. Aim to provide services so that at least 70% of residents within the Napier-Hastings urban area are within 500m walking distance of bus stops with all-day bidirectional service. 5. Subject to available funding, and where sufficient demand exists, look to introduce new services on a trial basis. Any trial should be subject to a minimum trial period of six months before any amendment or cessation. 6. Ensure the network caters for patterns of student travel that are likely to overcrowd public buses on scheduled urban services. 7. Consider the provision of extra services for special events a. which are non-commercial b. where there is free entry for the general public c. where over 5,000 attendees are expected d. where organisers will contribute one-third of the net cost of additional services
TRANSPORT DISADVANATAGED	HBRC will: 8. Consider the needs of those who are transport disadvantaged when providing services. 9. Ensure all services are operated by wheelchair accessible buses. 10. Ensure that the public transport network has accessible infrastructure that provides options to people of all abilities. 11. Actively engage with reference groups as subject matter experts in the design of bus stops, fare structures, customer experience, and service development to ensure equity in accessibility across the network, and that it is ,meeting the needs of all people using public transport services . 12. Continue to trial on demand services as a tool to enable greater access to the wider public transport network for the mobility impaired and aged communities with a view that the mode is a complementary network enabler.
HEALTH AND SAFETY	HBRC will: 13. Ensure vehicles operated under contract to HBRC meet the safety standards required by law and the quality standards set out in the Waka Kotahi NZ Transport Agency Requirements for Urban Buses, and that safety monitoring is undertaken through the Operator Safety Rating System. 14. Continue the current scheme, initiated with Hawke's Bay District Health Board with Health New Zealand to facilitate ease of travel for those needing to attend health appointments, while Health New Zealand, funding allows.

Policy Area	Policy
ENVIRONMENTALLY REPONSIBLE	HBRC will: 15. Ensure vehicles operated under contract to HBRC meet the environmental standards as set out in Waka Kotahi NZ Transport Agency Requirements for Urban Buses.
INTEGRATION WITH OTHER MODES	HBRC will: 16. Ensure that all buses used in HBRC services have bike racks. 17. Work with local authorities to improve integration of buses with cycling and walking. 18. Work with local authorities to achieve effective integration of multi modal transport, including the provision of secure bike storage and e-bike charging stations within easy reach of bus stops at key interchanges and locations such as Clive that are fed by cycleways that provide vital connections to more remote communities like Te Awanga and Haumoana.

4.2.3 Our Service

The purpose of this section is to ensure the experience of the customer is enhanced by having appropriate vehicles and infrastructure.

Objectives

- Public transport operations provide comfortable and safe travel, minimise adverse environmental effects and improve health outcomes.
- Provision of a high standard of infrastructure that supports the network of bus services.

Table 3: HBRC service policies

Policy Area	Policy
BUSES	HBRC will: 19. Ensure all vehicles providing services under contract are part of a consistent HBRC endorsed brand and colour scheme, while allowing reasonable operator branding. 20. Ensure all publications and marketing materials feature the HBRC endorsed brand and colour scheme 21. Permit suitable commercial advertising on the rear of buses only. 22. Investigate rollout of zero-tailpipe emissions buses earlier than required by government policy.
SERVICE PERFORMANCE	23. Provide high-quality, reliable services which create a first-class customer experience. 24. Specify high standards for reliability, timekeeping and customer service, and incentivise good service performance on all routes through bus operator contracts.

Policy Area	Policy
INFORMATION AVAILABILITY	25. Ensure service information is readily available and easy to understand. 26. Provide up to date information on all services on the HBRC network and encourage Hastings District Council and Napier Council to do the same 27. Make information available through social media (e.g. Facebook). 28. Ensure information for those with sight impairment is available.
FARES	29. Ensure fare payment systems are easy to use and accurately record passenger trip information. 30. Set fares in accordance with the targets and policies contained in the farebox recovery and fare-setting policy set out in Appendix D 31. Review fare levels annually in accordance with the policy set out in Appendix D. 32. Consider fare exemptions for the mobility impaired and their support companions, having regard to the balance of costs across all funded activities (i.e., whether the increased cost of further subsidising Public Transport fares is outweighed by the savings in total mobility subsidies).
PROCUREMENT, FUNDING AND DELIVERY	33. Consider the following criteria when establishing public transport units: a. Does the unit configuration form a marketable whole? b. What customer market would it serve? c. How attractive would it be to tenderers? (to encourage competition) d. Will the unit configuration maximise efficiency and achieve the best value for money possible? 34. Procure bus services using the partnering delivery model and the price quality selection method as set out in NZTA's Procurement Manual 2009 35. Maximise funding from NZTA. 36. Support the SuperGold Card free travel scheme funded by NZTA. 37. Explore partnership and bulk purchase opportunities with large employers, schools and other destinations.
COMMERCIAL PARTNERSHIPS	38. Consider opportunities to develop commercial partnerships with businesses to provide targeted public transport services that meet the needs of both the business community and employees in key employment nodes.

4.2.4 The experience

The purpose of this section is to ensure the experience of the customer is enhanced by having appropriate vehicles and infrastructure.

Objectives:

- Public transport operations provide comfortable and safe travel, minimise adverse environmental effects and improve health outcomes.
- Provision of a high standard of infrastructure that supports the network of bus services.

Table 4: HBRC experience policies

Policy Area	Policy
BUSES	HBRC will: 39. Ensure all vehicles operated under contract will meet the minimum vehicle quality specifications as set out in the NZTA Requirements for Urban Buses. 40. Provide wheelchair accessible vehicles on all services to ensure easy access for wheelchair users, parents with young children and passengers with mobility difficulties. 41. Ensure the appropriate size bus is used on each service by catering for peak loadings at the service peak time.
BUS STOPS AND TIMETABLE INFORMATION	42. Work with local authorities to add more bus shelters to the network. 43. Work with local councils to implement bus-stop improvements in line with Waka Kotahi Bus Stop Design Guidance. High use stops will be required to be well marked, with signage, shelters, high-quality footpath, kerbs and timetable information; and less frequently used stops will have road markings, signage and high-quality footpath kerbs and be well lit at a minimum. As stops are upgraded, they should generally be repositioned to sit in-line with the traffic lane to reduce delays for buses merging back into the traffic lane. 44. Liaise with Napier City and Hastings District Councils regarding improved access from bus stops to buses for people in wheelchairs 45. Ensure printed timetables are readily available, including large-print versions. 46. Provide high quality web timetable and journey planning information.

4.2.5 Looking forward

The purpose of this section is to ensure that public transport services cater for the changing needs of the population, including changes in residential and commercial areas; make provision for potential growth in demand for passenger services caused by increases in fuel prices; and recognise future developments in infrastructure technology.

Objective:

- A flexible network that adapts to changes in demand

Table 5: HBRC future network policies

Policy Area	Policy
DEMAND	HBRC will: 47. Improve service levels and the quality of the network to stimulate demand for public transport 48. Regularly review all services to ensure they meet the goals of the region including the contribution of PT systems to meeting VKT targets for tier 2 urban centres, as set under the emissions reduction plan. 49. Consider ongoing and potential changes in population, land-use and other factors that influence demand, to ensure the supply of services matches the demand. 50. Monitor the demand for rural services

Policy Area	Policy
	51. Carry out a two-yearly passenger survey in line with Waka Kotahi NZTA requirements 52. Investigate the longer-term potential for park and ride facilities serving rural areas and improved interchange and terminus facilities at key points in the urban network 53. Monitor and review the effectiveness, efficiency, and equity of the transition to a high frequency direct public transport model. Regular reviews should be undertaken with key stakeholders, annually.
TECHNOLOGY	1. Use changing technology where possible to provide a better service through improved ticketing systems and progressively implement integrated real time end to end trip information across the network and applicable channels (e.g., bus stops, applications, online, in-bus) 54.
INTEGRATION WITH OTHER SERVICES	55. Discuss any potential improvements for better integration and shared facilities for long-distance bus and/or tourism services with the relevant council.
PASSENGER RAIL	56. Work with other councils, KiwiRail, Waka Kotahi, Ministry of Transport, Government, and operators, to investigate opportunities for intra and inter regional passenger rail. This includes leadership and advocacy to promote better use of the rail network, and better funding structures. 57. Undertake a high-level feasibility study of future commuter rail inclusion in the wider Hawke's Bay Public Transport network.

4.3 Objective and policies for Total Mobility

4.3.1 Our customers

Table 6: HBRC total mobility customer policies

Policy Area	Policy
TRANSPORT FOR PEOPLE WITH A DISABILITY	HBRC will: 58. Continue to provide the Total Mobility Scheme in Napier, Hastings and Waipukurau in line with the policy set out by NZTA, while reserving the right to limit resources subject to funding and to operate within budget. 59. Subject to NZTA funding, make wheelchair payments for each wheelchair transported in a vehicle.

4.3.2 Your service

Objective:
A funding system for Total Mobility services that is fair to ratepayers and users of the service, is efficient and effective, and recognises the different benefits occurring to each funding party.

Table 7: HBRC total mobility service policies

Policy Area	Policy
INFORMATION AVAILABILITY	HBRC will: 60. Ensure information on the Total Mobility Scheme is readily available and easy to understand.
FARES	61. Ensure fare transaction systems are easy to use and accurately record passenger trip information.
FUNDING AND DELIVERY	62. Maximise funding from Waka Kotahi NZ Transport Agency. 63. Consider applications from transport operators for the provision of Total Mobility transport services, while reserving the right to decline applications where: a. Demand cannot be demonstrated b. Adequate services are in operation c. Value for money cannot be demonstrated.

4.3.3 The experience

Objective:
A Total Mobility service that provides comfortable and safe travel

Table 8: HBRC total mobility experience policies

Policy Area	Policy
ACCESSIBLE VEHICLES	HBRC will: 64. Subject to NZTA funding, provide grants for the installation of wheelchair hoists.
HEALTH AND SAFETY	HBRC will: 65. Ensure vehicles operated under contract to HBRC meet the safety standards required by law. 66. Ensure Total Mobility providers have health and safety policies and procedures in place which meet the requirements of the Health and Safety at Work Act 2015.
TECHNOLOGY	67. Operate smartcard transaction technology for Total Mobility in the region, to support more independent travel.

4.3.4 Looking forward

Objective:
A flexible service that adapts to changes in demand.

Table 9: HBRC total mobility future policies

Policy Area	Policy
DEMAND	HBRC will: 68. Consider changes in population demographics, land use and other factors that influence demand on the Total Mobility Scheme, as opportunities to improve the Public Transport Network to ensure a range of options are provided to people of all abilities.
TECHNOLOGY	69. Use changing technology where possible to provide a better service.

4.4 Objectives and policies for Community Transport

Objective:
Support existing and implementation of new community-based transport solutions for smaller settlements outside of the primary urban areas

Table 10: HBRC community transport policies

Policy Area	Policy
DEMAND	HBRC will: 70. Provide support for community transport services where: a. There is a demonstrated need for a transport service in communities outside the urban areas of Hastings and Napier, such as Wairoa, Central Hawke's Bay, Whirinaki and Cape Coast.. b. There is willingness by members of the community to set up, operate and maintain a trust or similar structure to oversee governance of the service, and for people to volunteer to be drivers. c. There is sufficient funding available to support the establishment and administration of the trust and the purchase of vehicle(s). d. The establishment of the trust has the support of the relevant territorial authority. 71. Support for community transport services will be assessed on a case-by-case basis and may include: e. Council staff assistance to establish a Trust or service in a new area where a request is received from the relevant local authority, community board or residents' group. f. Financial grants towards vehicle purchase/replacement and Trust administration costs, subject to availability of funding. g. Provision of supporting technology to help make community transport services easier to manage and more accessible for users, subject to availability of funding. h. Where possible leverage council's purchasing ability to obtain best value for community vehicle/hoist purchase, and/or other professional services such as driver training. 2. Ensure the core purpose of the service remains to connect the outlying community with the main public transport network.

5 What we plan to do

5.1 Strategic response

To address the issues identified through our consultation and network review processes (refer Section 1), we have developed several strategic responses, and from these, a number of action points to be implemented over the next three years, in addition to the provision of existing services.

1. **Deliver a new "step change" network upon the start of the next contract period.**

The existing bus operating contract finishes mid-2025, and new contracts will need to be tendered at this time. This provides an opportunity to reset and scale up the urban public transport network.
The new network will be a "step change" improvement over the current bus system, designed to make public transport a viable attractive option for more journeys within the Napier Hastings Urban Area, and lead to significant growth in patronage. The network will focus on:

- **Legible bi-directional routes,** replacing the slow and indirect one-way loops of the existing network with two-way routes on more direct alignments.
- **Increased all-day service frequency** across all routes, with investment targeting connections to major employment, education, retail destinations and essential needs.
- **Increased span of service**, with all urban services running from 6am to 9pm, seven days a week.

This is a step change in terms of level of service, in particularly the frequency and span, and is expected to deliver increased patronage.
These improvements, as well as further service improvements, to frequency and span of service, to be in place by 2030, are detailed in APPENDIX A.

2. **Deliver interim service improvements ahead of new network delivery**

Simple service improvements do not need to wait until 2025. Subject to availability of funding, improvements to the span and frequency within the existing network will be prioritised.
We will continue MyWay as a trial and use it as tool to introduce more reliable and frequent PT to the community to encourage the step change, and an improvement in perception and uptake of PT. We will monitor outcomes to understand where it may work better for users and more efficiently than fixed route. In these areas it may replace some of the proposed network or compliment it where necessary or in areas not well served by the fixed route network.
Investigate and implement innovative ways to provide better transport options in small towns and rural areas.
HBRC would like to further improve access for residents in accordance with the objectives of the Government Policy Statement for Land Transport and intends to explore more flexible ways in which this could be achieved in a cost-effective manner. This will involve looking wider than conventional bus services and exploring options such as community van services.

5.2 Planned activities

The following activities are planned for the next three years. These are not listed in any particular order, as programming will depend on resources available and external factors. However, the items have an indicative timeframe based on relevant factors.

Table 11: Planned activities for the next three years

Initiative	Details	Indicative timeframe
Improve journey time and journey time reliability	To include consideration of: • streamlining routes to reduce dead-running • timetable revision to reflect more accurately running times • Increasing frequencies to reduce waiting time and minimise the impacts of any delays that do occur.	2022/23
Investigate options to partner with organisations and businesses to promote commuter bus use through concession fare schemes.	Build upon existing partnerships model which has been successful with Fallen Soldiers' Hospital	Annual
Trial a commuter express bus service between the Central Hawkes Bay towns of Waipukurau, Waipawa and Ōtāne through to Hastings.	Operating two morning peak services to Hastings from Waipukurau, via Waipawa, and Otane, with two evening return services to Waipukurau from Hastings.	Implementation by 2025, with option to fast track the trial subject to availability of funding for the trial.
Community Transport in Wairoa	Identify existing initiatives and support the establishment of a Trust to run Community Transport services in Wairoa.	Implementation by 2024
Evaluate outcomes of on-demand trial in Hastings and identify possible uses within an integrated 2025 network	We will continue to use MyWay as a trial, and as tool to reintroduce PT to the community to encourage step change, and an improvement in perception and uptake of PT. We will continue monitoring it – if it works better and is more efficient than fixed route, it may replace some of this proposed network, or compliment it where necessary.	2023 post trial period
Implement planned 2025 'Step change' fixed route bus network when re-tendering network operating contracts.	See Appendix A for details	2025 at end of existing contract period

6 Review and monitoring

6.1 Monitoring

The purpose of monitoring the implementation of the Plan is:

- to measure whether the Plan has been successful in meeting regional public transport objectives; and
- to measure the quality of the services provided.

The region's objectives for public transport are set out in the Regional Land Transport Plan 2021-31 (RLTP). The RLTP has the following vision:
"Hawke's Bay's transport network fosters a vibrant, accessible and sustainable carbon neutral Hawke's Bay"
Supporting strategic objectives include:

- Achieve a safe transport system for users.
- Achieve a transport network that is resilient, reliable, and efficient.
- Provide transport choices to meet social, environmental, and cultural needs.
- Develop a transport system that contributes to a carbon neutral Hawkes Bay
- Minimise travel demand through planning and development.

Policies relevant to public transport to achieve these objectives are:

- Transition to public transport options that are realistic, attractive and energy efficient alternatives to the private car for key journeys especially for travel to work and school for all of Hawke's Bay
- Review public transport service delivery and develop new services and solutions for attractive and efficient public transport, including working in partnership with stakeholders to promote the expansion of public and shared transport incentive programmes and supporting investigation into use of rail for commuter passengers to meet people's social, economic, and cultural needs in all of Hawke's Bay.

This draft RPTP contains HBRC's specific vision for public transport in Hawke's Bay which is:
"To deliver a public transport that is safe, accessible and supports the shift to reduce driving and emissions in Hawke's Bay, while improving the economic, social, and environmental well-being of the people of Hawke's Bay".
With respect to the RLTP objective and methods and the vision statement of this Plan, we aim to:

- Improve reliability and customer experience on the existing network.
- Identify and implement improvements to span and frequency of existing routes where funding allows.
- Trial new commuter express route from Central Hawke's Bay to Hastings.
- Prepare for rollout of new network, including identifying infrastructure required to support the network change

6.2 Information requirements

HBRC will require information from public transport operators in accordance with LTMA requirements for information disclosure. The LTMA permits councils to require the operator of a public transport unit to supply fare revenue and patronage data. HBRC must publicise the patronage data and the extent to which a unit is subsidised.

6.3 Review

The RPTP must be reviewed every three years. At that time, HBRC will consider whether a formal renewal of the Plan should be undertaken. If changes are warranted, the significance policy for variations to the

Plan may be triggered (Refer Appendix E for our significance policy) and this will tell HBRC how widely it must consult affected parties and the community about the variation. However, in all cases HBRC will consult with persons who will or may be affected by or have an interest in the proposed variation in accordance with Sections 126(4) and 125(2) (a) of the LTMA and Section 82 of the LGA. Reviews will be undertaken to coincide with the review of the Regional Land Transport Plan (RLTP). This will help to ensure that the RPTP is consistent with the public transport objectives of the RLTP.

7 Legislative requirements

An RPTP must contribute to the purpose of the LTMA and meet certain other requirements. A description of how this draft Plan complies with those requirements is set out in Appendix C.

8 Farebox Recovery policy

Previously, we were required to set regional targets and policy for farebox recovery as a condition of funding under a National Farebox Recovery Policy. Changes to national funding policy in mid-2018, mean we have no longer been required to comply with a national farebox recovery target. Therefore, we have no regional targets for farebox recovery set for the term of this Plan.

However, the underlying principles of the previous farebox recovery are still relevant when developing regional fare policies:

- Fares will continue to play an important role in helping cover the cost of public transport (along with regional and national subsidies).
- Fare recovery policies should be consistent with other related central and local government policies and plans.
- There may be flow-on impacts to the wider public transport system from fare structure/pricing that should be recognised.
- Fare recovery should not be the only driver in setting fare levels but should be part of a wider assessment.

Monitoring of farebox recovery rates using the methodology and reporting process specified by Waka Kotahi New Zealand Transport Agency is still required. This is documented in Appendix D. HBRC will continue making funding decisions in accordance with the policies set out in the Long-Term Plan (LTP).

9 Significance policy

Refer to Appendix E for further information.

10 Consultation undertaken

Consultation has been undertaken in the review of this plan, in accordance with the requirements of Section 125(1) of the LTMA.

- A review of the existing public transport network and services by external consultants.
- An early consultation round with elected members from the Regional Transport Committee.

Glossary and abbreviations

Term/Acronym	Meaning
DHB	District Health Board
ERP	Emissions Reduction Plan
HBRC	Hawke's Bay Regional Council
GPS	Government Policy Statement
LTMA	Land Transport Management Act
LTP/Long Term Plan	A plan prepared by all local authorities under the Local Government Act which covers a period of at least ten years (also known as the Ten-Year Plan)
MoE	Ministry of Education
NLTF	National Land Transport Fund
NLTP	National Land Transport Programme
Waka Kotahi	New Zealand Transport Agency
PTOM	Public Transport Operating Model
RLTP	Hawke's Bay Regional Land Transport Plan
SuperGold Card	A discount and concessions card issued free to all NZ residents aged 65 and over and those under 65 receiving a Veteran's Pension or NZ Superannuation. SuperGold Card holders can travel free of charge on public transport between 9am and 3pm on weekdays and anytime at the weekend or on Public Holidays
Ten Year Plan	A plan prepared by all local authorities under the Local Government Act which covers a period of at least ten years (also known as the Long-Term Plan)
The Plan, RPTP	Hawke's Bay Regional Public Transport Plan
Total Mobility	A nationwide scheme which provides discounted taxi travel for people with disabilities which prevent them from using buses

Appendix A Planned service improvements

Route 1: Primary Trunk Service - Napier to Hastings, Havelock North via Taradale shops, EIT/PGA & Fallen Soldiers' Hospital

Route Description

This trunk route will be the core service of the new network and primary driver of public transport patronage in the region (shown in Figure 6 below). It will connect most of the major destinations (Napier CBD, Tamatea shops, Taradale shops, EIT/PGA, Fallen Soldiers Hospital, Hastings CBD, Havelock North Village) to many different smaller destinations and residential areas with fast, frequent service. The route will mostly follow the same path as the existing Route 12 but with a much higher level of service throughout the day and week.

The path will differ from Route 12 in the following ways:

- Route via Nottingley Road & Percival Road in Hastings instead of Pakowhai Road, as described in the year 1-3 improvements, above. This gives the following benefits:
  - Avoid having to make a two-kilometre detour, including U-turn, to serve the hospital
  - Serve Hawke's Bay Regional Sports Park, which has been widely requested by stakeholders.
- Removal of the current Tait Drive deviation in Napier to improve travel time and reliability, as described in the year 1-3 improvements, above.
- Extension to Havelock North.
- The route will split in two at the Havelock North town centre with one 'tail' going east along Te Mata Road and the other going west along Te Aute Road (see Figure 5). These will be evenly split from the trunk, operating at every 30 minutes.

Frequency and Span

Span: This service will run from 6am to 9pm, 7 days a week. Frequency will be every 15 minutes from 7am-7pm and every 30 minutes all other times

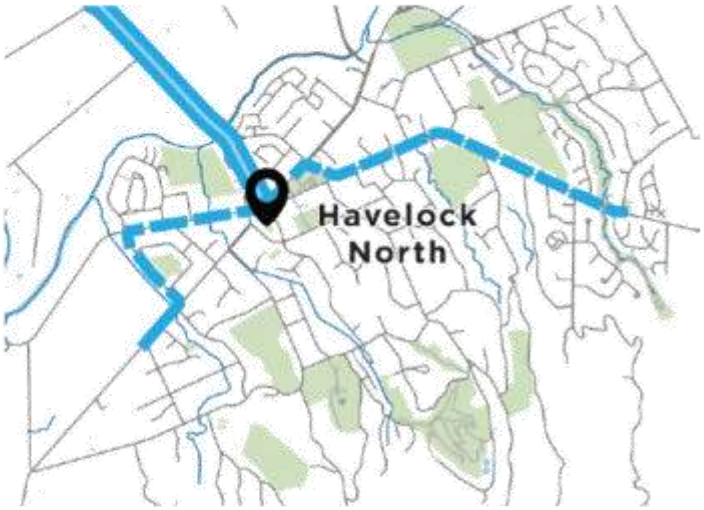

Figure 5: Split the trunk into two tails at a 30-minute frequency each

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Figure 6: Route 1 preferred option full map

Route 2: Eastern Institute of Technology to Napier via Taradale, Tamatea & Kmart

Route Description

This route will connect residential Taradale, Tamatea and the new Parklands developments to Napier CBD, Kmart, Tamatea shops, Taradale shops and EIT/PGA. There will be an easy connection to the trunk line to continue to Hastings, Havelock North, and the hospital.

The route will follow a similar path as the current Route 13, with the following changes:

- Removal of complicated one-way loops.
- New routing via Orotu Dr and Prebensen Drive to serve new residential and commercial developments (Kmart).
- Extension to EIT/PGA, with service to residential areas in southwest Taradale.

Frequency and Span

- Span: This service will run from 6am to 9pm in 2025 and 6am to midnight by 2030, 7 days a week.
- Frequency will be every 20 minutes in 2025 (15 minutes by 2030) from 7am-7pm and every 30 minutes all other times.

Options

Two route options are proposed between Kmart and Napier CBD (options shown in Figure 7 **Error! Reference source not found.**below):

1. Option 1 would provide a more direct trip to Napier CBD via Prebensen Drive and Thackeray Street. This option would require either creating a safe stop and crossing on the state highway or a deviation into the Kmart complex.
2. Option 2 would travel via Ford Road, Taradale Road, Alpers Terrace and Kennedy Road. This would be a longer trip but would:
   a) Provide easier access to the Kmart complex.
   b) Provide service to parts of the Onekawa industrial area and Marewa neighbourhood that would not otherwise be served.

These options were consulted on during the RPTP consultation process, and resulted in the second option being most favoured, due to demand for access to the Onekawa Industrial area, and associated businesses. Route 2 is now confirmed to be turning right at Ford Road and travelling via Onekawa and Marewa to Napier CBD.

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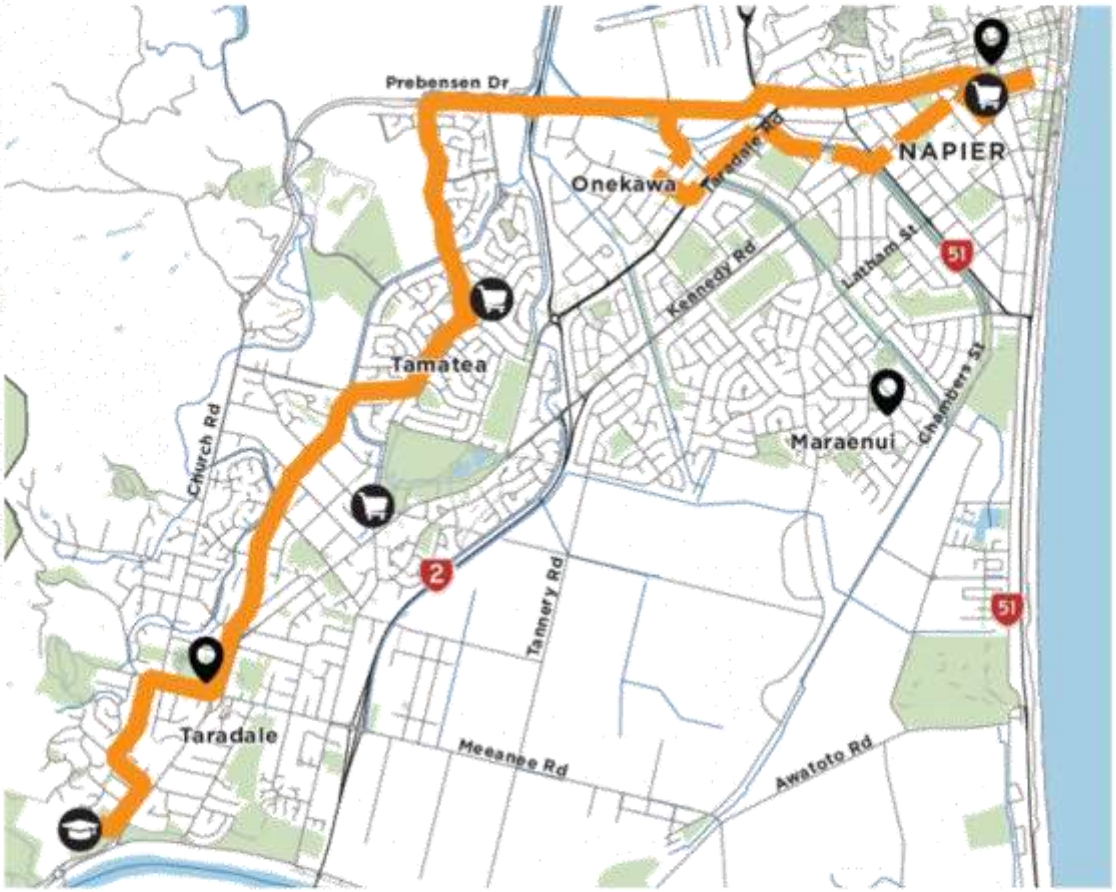

Figure 7: Route 2 options map

Route 3: Tamatea to Napier via Maraenui

Route Description

- Replacement of the current Route 14
- Removal of one-way loops through Maraenui
- Connecting key destinations through:
  - Napier City Centre
  - McLean Park
  - Maraenui Shops
  - Tamatea Shops, providing access to the supermarket, pharmacy, medical centre, and other services in the Tamatea centre

This route is shown in Figure 8 below. The extension through to Tamatea shops provides the opportunity to interchange with Route 1 and Route 2 to access the rest of the network.

Frequency and Span

- Span: This service will run from 6am to 9pm in 2025 and 6am to midnight by 2030, 7 days a week.
- Frequency will be every 20 minutes in 2025 (15 minutes by 2030) from 7am-7pm and every 30 minutes all other times.

Options

- The route could be rerouted to serve proposed Riverbend Residential Development which could deliver up to 670 homes at 215 Riverbend Road. This would require the street network within the new development being designed to allow through running of buses to Waterworth Avenue.

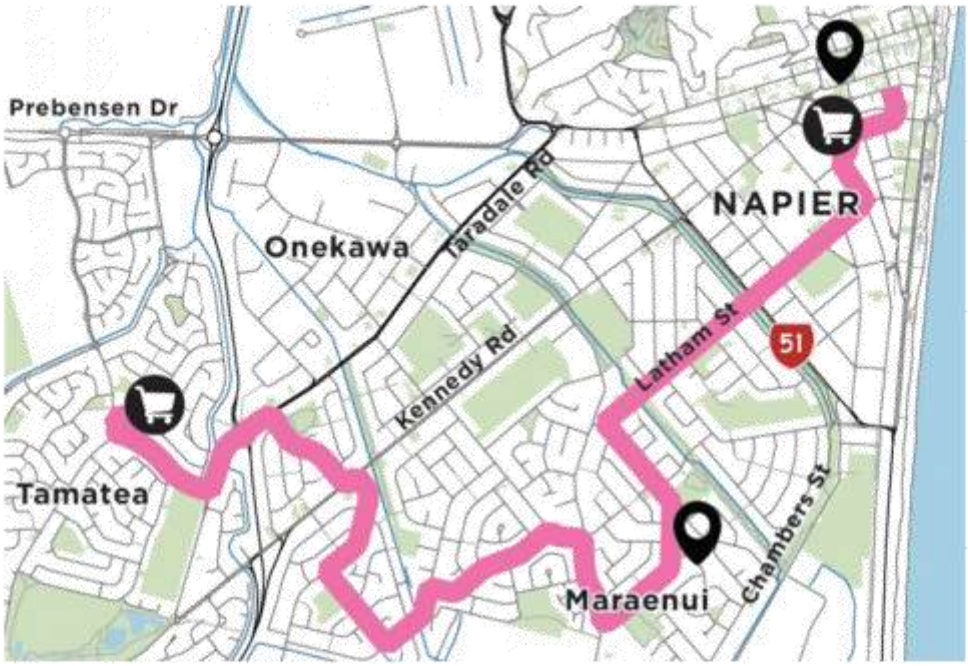

Figure 8: Proposed Route 3 map

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Route 4: Flaxmere to Akina via Fallen Soldiers' Hospital, Mahora and the Hastings City Centre

Route Description

- Partial replacement of the current Route 20, new route shown in Figure 9 below.
- In combination with the new Route 4, this route allows for the removal of one-way loops in Flaxmere while maintaining a good level of coverage.
- Provides direct, frequent connections to Trunk Route 1, providing connection to EIT/PGA and Napier city for Flaxmere, Mahora and Akina with the following direct connections:
  - Flaxmere to/from Hospital and onward to Hastings CBD, with deviation.
  - Mahora to/from Hospital and Hastings CBD
  - Akina to/from Hastings CBD and onward to Hospital, with deviation.

Frequency and Span

- Span: This service will run from 6am to 9pm in 2025 and 6am to midnight by 2030, 7 days a week.
- Frequency will be every 20 minutes in 2025 (15 minutes by 2030) from 7am-7pm and every 30 minutes all other times.

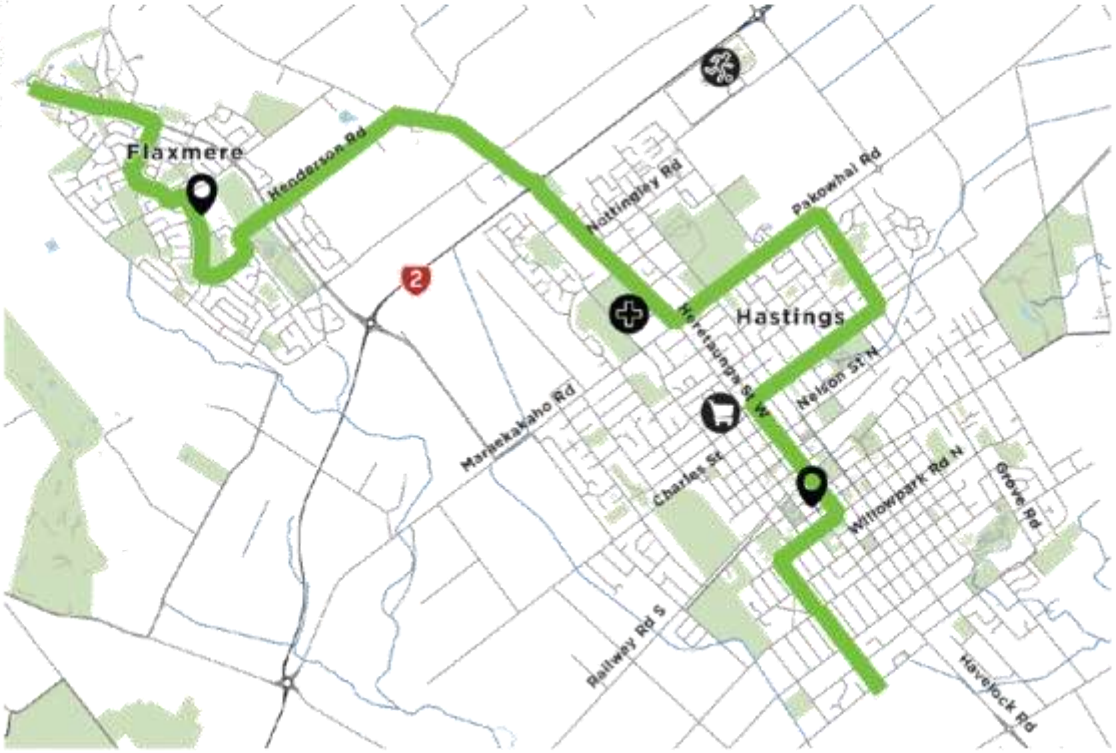

Figure 9: Route 4 options map

Route 5: Flaxmere to Karamu via Raureka and Hastings City Centre

Route Description

- Partial replacement of the current Route 20
- In combination with the new Route 5, this route allows for the removal of one-way loops in Flaxmere while maintaining good coverage.
- Through routing to Karamu improves access to western side of the city centre, high schools and facilities in Windsor Park, including Splash Planet.
- Route is shown in Figure 10 below

Frequency and Span

- Span: This service will run from 6am to 9pm in 2025 and 6am to midnight by 2030, 7 days a week.
- Frequency will be every 20 minutes in 2025 (15 minutes by 2030) from 7am-7pm and every 30 minutes all other times.

Figure 10: Proposed Route 5

19 September 2022 12.33 pm

Route 6: Napier to Hawke's Bay Airport via Bluff Hill and Ahuriri

Route Description

- Replacement of the current Route 15
- Removal of one-way loops through Ahuriri and Westshore
- Shortened from Bay View to provide access to the Airport for employees and tourists.
- Shown in Figure 11 below

Frequency and Span

- Every 60-minutes between 6am-9pm, 7 days a week

Figure 11: Proposed Route 6

Route 7: Fallen Soldiers' Hospital to Hastings City Centre via Camberley and Raureka

Route Description

- Coverage route to provide service to areas of Camberley and Raureka which are not directly served by the frequent routes.
- Connections to hospital & Hastings CBD.
- Shown in Figure 12 below.

Frequency and Span

- Every 60-minutes between 6am-9pm, 7 days a week

Figure 12: Route 7 map

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Route 8: Hastings to Napier via Whakatu, Clive and Te Awa

Route Description

- Modification of the current Route 11, from a peak express service to an all-day service.
- This route will not serve Havelock North, as does Route 11, but frequency and connectivity to Havelock North will be increased significantly by being connected to the frequent trunk service.
- Unlike Route 11, this route will serve a stop in Whakatu, via a small deviation from the state highway.
- Shown in below.

Frequency and Span

- Every 60-minutes between 6am-9pm, 7 days a week

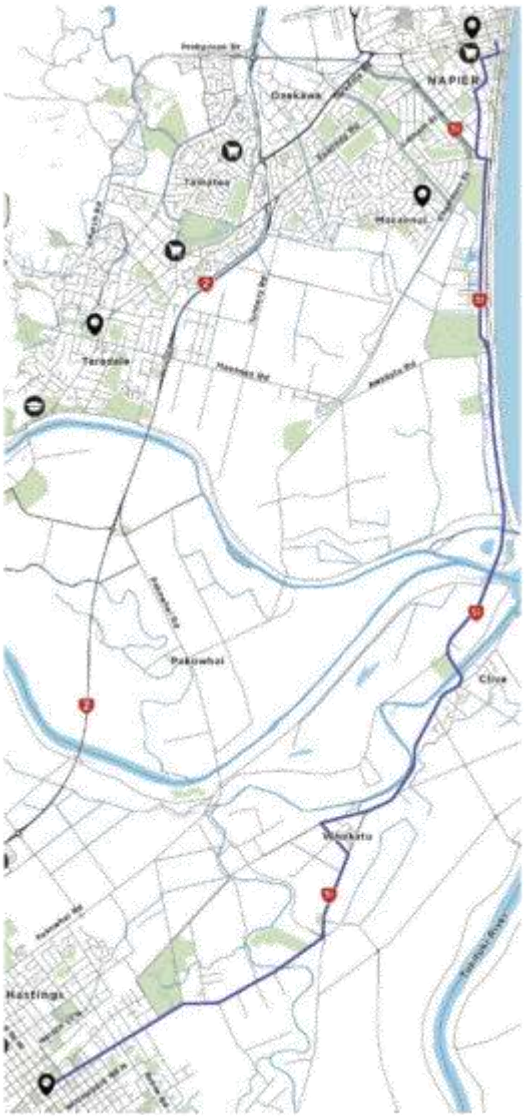

Figure 13: Route 8 map

Route 9: Central Hawke's Bay Peak Express

Route Description

- New limited-stop service targeting commuters from Central Hawke's Bay to Hastings. From there, people can easily transfer to the frequent trunk route and other frequent routes with minimal wait time.
- Stops at:
  - Waipukurau outside the Visitor Information Centre,
  - Waipawa on High Street Northbound and using the existing off-street stop southbound.
  - Ōtāne stopping outside the Town Hall and using the Higginson, Miller, Ross Street triangle to turn the bus around to head back to the state highway.
- Route map shown in Figure 14 below.

Frequency and Span

- Two AM peak services to Hastings, two PM peak services to Central Hawke's Bay, weekdays only.

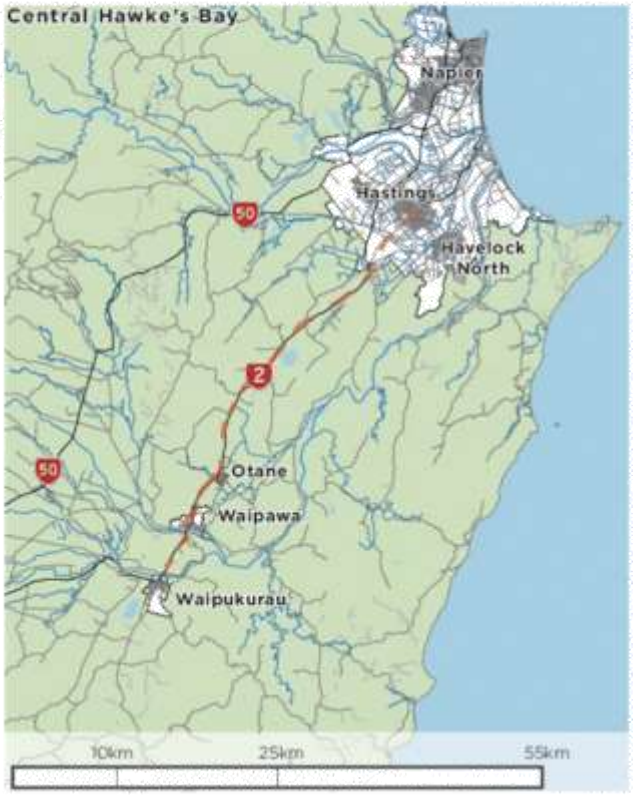

Figure 14: Proposed Route 9 map

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Appendix B Description of services integral to the Hawke's Bay public transport network and unit delineation

Current 2022 Network services and unit delineation

Service	Route	Approximate frequency	Unit Description
10 Express	Between Napier and Hastings	Peak time weekday service, 2 in the morning and 1 in the late afternoon between Napier and Hastings. Two in the late afternoon between Hastings and Napier	Napier Hastings Unit Commenced 1 July 2016
11 Express	Between Havelock North and Napier, via Hastings and Clive	Peak time weekday service, 4 in the morning and 4 in the late afternoon	Napier Hastings Unit Commenced 1 July 2016
12N	Napier to Hastings via Taradale, EIT, Hawke's Bay Hospital and Bay Plaza	Every 20 minutes in peak time and 30 minutes in off-peak times, 6.30am to 6.30pm weekdays Every hour on Saturdays/Public Holidays between 8am and 6.30pm Every 2 hours on Sundays/Public Holidays between 9am and 5.40pm	Napier Hastings Unit Commenced 1 July 2016
12H	Hastings to Napier, via Bay Plaza, Hawke's Bay Hospital, EIT and Taradale	Every 20 minutes in peak times and 30 minutes in off-peak times, 6.30am to 6.30pm Every hour on Saturdays/Public Holidays between 8am and 6.30pm Every hour on Sundays/Public Holidays between 8am and 4.55pm	Napier Hastings Unit Commenced 1 July 2016
13	Napier-Maraenui-Onekawa-Napier	Every hour between 7am and 6pm, weekdays Approximately every 1¾	Napier Hastings Unit Commenced 1 July 2016

Service	Route	Approximate frequency	Unit Description
		hours on Saturdays/Public Holidays, between 8am and 5.20pm	
14	Napier-Maraenui-Onekawa-Napier	Every 40 minutes in peak times and hourly in off-peak times, between 6.50am and 5.55pm, weekdays Every 1¾ hours, between 9am and 4.25pm on Saturdays/Public Holidays	Napier Hastings Unit Commenced 1 July 2016
15	Napier-Ahuriri-Westshore-Bay View, Westshore, Ahuriri-Napier	Every hour between 6.45am and 6.20pm, weekdays (5 trips per day to Bat View Every two hours between 10am and 2pm on Saturdays/Public Holidays	Napier Hastings Unit Commenced 1 July 2016
16A	Hastings-Camberley-Raureka Hastings	Every hour between 7.25am and 5.15pm, weekdays	Napier Hastings Unit Commenced 1 July 2016
16B	Hastings-Mahora-Hastings	Every 2 hours between 8am and 5.15pm, weekdays	Napier Hastings Unit Commenced 1 July 2016
17	Hastings-Parkvale-Akina-Hastings	Approximately every hour between 7.30am and 5.15pm, weekdays	Napier Hastings Unit Commenced 1 July 2016
20	Hastings-Flaxmere-Hastings	Every 30 minutes in peak times and hourly off-peak times between 6am and 6.05pm, weekdays Every 1-2 hours between 8am and 5.50pm on Saturdays/Public Holidays. Three trips on Sundays	Napier Hastings Unit Commenced 1 July 2016

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Service	Route	Approximate frequency	Unit Description
21	Hastings-Havelock North-Hastings	Every 30 minutes in peak times and hourly in off-peak times between 6am and 6.05pm, weekdays Every 2 hours between 9am and 4.50pm on Saturday/Public Holidays. Three trips on Sundays	Napier Hastings Unit Commenced 1 July 2016

Proposed 2025 Network

Unit 1: Hastings unit

Service	Route	Frequency	Unit Description
1	Between Napier, Hastings & Havelock North	• Every 15 minutes 7am-7pm, 7 days a week • Every 30-minute frequency between 6am-7am and 7pm-9pm, 7 days a week	
4	Flaxmere to Akina via Hastings	• Every 20 minutes 7am-7pm, 7 days a week • Every 30-minute frequency between 6am-7am and 7pm-9pm, 7 days a week	
5	Flaxmere to Karamu via Hastings	• Every 20 minutes 7am-7pm, 7 days a week • Every 30-minute frequency between 6am-7am and 7pm-9pm, 7 days a week	
7	Hastings to Hospital via Raureka and Camberly	• Every 60 minutes 6am-9pm, 7 days a week	
9	Waipukurau to Hastings City Centre via	2 AM peak services to Hastings, 2 PM peak services to Central	

Service	Route	Frequency	Unit Description
		Hawke's Bay, weekdays only	

Unit 2: Napier Unit

Service	Route	Frequency	Unit Description
2	EIT to Napier via Tamatea	• Every 20 minutes 7am-7pm, 7 days a week • Every 30-minute frequency between 6am-7am and 7pm-9pm, 7 days a week	
3	Tamatea to Napier via Maraenui	• Every 20 minutes 7am-7pm, 7 days a week • Every 30-minute frequency between 6am-7am and 7pm-9pm, 7 days a week	
6	Napier to Hawke's Bay Airport via Bluff Hill and Ahuriri	• Every 60 minutes 6am-9pm, 7 days a week	
8	Hastings to Napier via Mahora, Whakatu, Clive and Te Awa	• Every 60 minutes 6am-9pm, 7 days a week	

TOTAL MOBILITY

The Total Mobility Scheme caters for those people with disabilities who are unable to use buses. HBRC intends to continue to operate the scheme in:
Napier (24 hours a day, 7 days a week, Napier city and suburbs, and between Napier and Hastings)
Hastings (24 hours a day, 7 days a week, Hastings City and suburbs, and between Hastings and Napier)
Central Hawke's Bay (14 hours a day, 6 days a week)

EXEMPT SERVICES

The LTMA requires all exempt services in a region to be registered before operation. The following services are exempt:

- inter-regional public transport services,
- a public transport service, that:

a) begins, or is to begin, operating after the Plan is adopted is not identified in the Plan as integral to the public transport network, and operates without a subsidy for the provision of the service

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b) ferry services, registered with council as a commercial public transport service before 30 June 2011
c) bus services, registered with council as a commercial public transport service before 30 June 2011 that did not offer fares in accordance with the fare schedule published by HBRC
d) a public transport service that began operating after 30 June 2011 that is not identified in the Plan and operates without a subsidy, and
e) a public transport service that is specified as exempt by an Order in Council

Exempt services are not included in this Plan. Potential operators of exempt services should contact HBRC for details or refer to Section 133 of the Land Transport Management Act 2003 for details of registration requirements. Registration is free but must be completed at least fifteen working days before the commencement of the service.

In Hawke's Bay there are some exempt services that operate without any financial support from HBRC. As these services operate independently, operators are able to set fares, timetables and routes as they see appropriate. HBRC's general approach is that there is no need to intervene in the provision of an exempt public transport service.

The LTMA does however, enable regional councils to require information from operators of commercial units, where these are included in the Plan for public transport planning, contracting, and monitoring purposes. If HBRC considers that a contracted commercial public transport unit does not meet the needs of the community, HBRC and the operator will review the service.

Following the review, if improvements cannot be made commercially, HBRC may choose to intervene by
a) developing a unit and providing a concessionary fare scheme or
b) offering improved services by way of competitive tender and securing a contracted operator. There are currently no contracted commercial units in Hawke's Bay.
There are currently no contracted commercial units in Hawke's Bay.

Appendix C Legislative requirements

The Land Transport Management Act 2003 (LTMA) requires a council to consider certain matters when preparing its plan. Section 124 requires councils to:

a) Be satisfied that the plan
   i) Contributes to the purpose of the LTMA
   ii) Has been prepared in accordance with any relevant guidelines that the Agency has issued
   iii) Is, if it includes a matter that is not within the scope of the RLTP, otherwise consistent with that plan.
b) Be satisfied that it has applied the principles specified within Section 115(1).
c) Take into account
   i) Any national energy efficiency and conservation strategy
   ii) Any relevant regional policy statement, regional plan, district plan or proposed regional plan or district plan prepared under the RMA
   iii) The public transport funding likely to be available within the region
   iv) The need to obtain the best value for money, having regard to the desirability of encouraging a competitive and efficient market for public transport services; and
   v) The views of public transport operators in the region.
d) Consider the needs of persons who are transport disadvantaged.

HBRC is satisfied that this draft Plan contributes to the LTMA.

LTMA REQUIREMENT	CONTRIBUTION OF THIS PLAN
Contributes to the purpose of the LTMA which is to contribute to an effective, efficient, and safe land transport system in the public interest.	The draft Plan sets out policies that will improve access and mobility, efficiently use existing capacity and resources, and encourage use of the Hawke's Bay public transport network. Safety is improved through high vehicle standards. Increased public transport use reduces the personal risk of car crashes.
Has been prepared in accordance with any relevant guidelines that the Agency has issued.	NZTA's 2013 "Guidelines for Preparing Regional Public Transport Plans" have been followed when preparing this plan.
Is, if it includes a matter that is not within the scope of the RLTP, otherwise consistent with that plan	Matters considered within this draft Plan are within the scope of the Regional Land Transport Plan.
Be satisfied that it has applied the principles specified within section 115 (1), namely a) HBRC and public transport operators should work in partnership and collaborate with territorial authorities to deliver the regional public transport services and infrastructure necessary to meet the needs of passengers b) The provision of public transport services should be coordinated with the aim of achieving the levels of integration, reliability, frequency, and	Section 2.3 outlines how HBRC will work with public transport operators and territorial authorities. The definition of one unit for the Hawke's Bay bus network will ensure full integration of services. Frequency and coverage have been given consideration in the network review undertaken prior to the development of the draft Plan. Reliability is addressed through the policies contained in this plan on the performance of the bus service. The definition of one unit for the Hawke's Bay bus network encourages competition, being large enough to achieve economies of scale but not too large to

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LTMA REQUIREMENT	CONTRIBUTION OF THIS PLAN
coverage necessary to encourage passenger growth c) Competitors should have access to regional public transport markets to increase confidence that public transport services are priced efficiently d) Incentives should exist to reduce reliance on public subsidies to cover the cost of providing public transport services e) The planning and procurement of public transport services should be transparent	discourage smaller operators. The procurement policies in this draft Plan will also encourage competition. Incentives such as the Financial Incentive Mechanism and performance monitoring (key principles of PTOM) should help to encourage high quality performance and innovation, leading to increased patronage and reduced reliance on public subsidy. The draft Plan describes how HBRC plans and procures services.
Take into account i) Any national energy efficiency and conservation strategy; and ii) Any relevant regional policy statement, regional plan, district plan or proposed regional plan or district plan prepared under the RMA iii) The public transport funding likely to be available within the region iv) The need to obtain the best value for money, having regard to the desirability of encouraging a competitive and efficient market for public transport services; and v) The views of public transport operators in the region	One of the priority focus areas of the New Zealand Energy Efficiency and Conservation Strategy 2017 is efficient, low emissions transport. Provision of commuter bus services will contribute to this priority. The high vehicle standards required by the plan are consistent with the objectives of the 2017 strategy. These plans are supportive of the integration of public transport network planning and land use planning. The planning of commuter bus routes and neighbourhood access routes takes land use into consideration. The services listed in this plan take available funding into account and are deemed affordable. Proposed future developments will be evaluated in terms of affordability and available funding when investigated. Policies in Section 4 of the Plan set out how HBRC will procure its services to encourage competition and achieve value for money. These principles are further elaborated in HBRC's procurement strategy. All public transport operators in Hawke's Bay and neighbouring regions were invited to provide their views on a range of matters during the development of the draft Plan.
Consider the needs of persons who are transport disadvantaged	Section 3 of the draft Plan sets out how the needs of the transport disadvantaged have been considered.

Appendix D Farebox recovery monitoring and fare-setting policy

INTRODUCTION

The changes to national funding policy in mid-2018 mean HBRC are no longer required to set a regional target for farebox recovery. However, monitoring of farebox recovery rates using the methodology and reporting process specified by Waka Kotahi is still required.

SERVICES INCLUDED IN CALCULATION

The public transport services to be included in the calculation of the fare recovery are all HBRC contracted services operating in the region. Long-distance (e.g., inter-city services) services, privately funded school services, Ministry of Education funded school services; tourist and charter services are not included.

THE FAREBOX RECOVERY RATE

HBRC monitors the farebox recovery of the system as a whole rather than measuring individual routes or trips. Individual routes or services, particularly those designed to primarily play a coverage role, are not necessarily expected to achieve the target set out in this policy.

Table 12 below shows the actual farebox recovery level for the latest full financial year (1 July 2020 to 30 June 2021). All figures have been calculated using the NZTA farebox recovery formula.

Table 12: Farebox recovery rates by year

Year	Farebox Recovery Rate
2011-12	33.00%
2012-13	32.50%
2013-14	37.53%
2014-15	38.94%
2015-16	37.80%
2016-17	38.50%
2017-18	37.00%
2018-19	34.00%
2019-20	24.00%
2020-21	19.00%

METHOD OF CALCULATION

The formula used to calculate farebox recovery is prescribed by NZTA and is set out in detail on its website. In essence the formula is total fare revenue divided by total costs.

FARE–SETTING

An annual fare level review will be undertaken at the conclusion of each financial year. This review will take into consideration the farebox recovery levels but may also include any other factors HBRC considers relevant. As a general principle, fare levels should remain competitive with the price of private car travel to encourage patronage growth, particularly for commuting. However, this will need to be balanced with ensuring that passengers contribute sufficiently to the cost of operating the service.

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The review will also address the level of discounts and concessions within the existing fare structure.

FARE STRUCTURE REVIEW

The fare structure on the HBRC network is currently a flat fare structure with it being $1 for one zone and $2 for two zones with a Bee Card.

HBRC will review fare structures at least every six years. The fare structure review will address all aspects of the fare system, including

- the appropriateness of zones as the base for the system, and
- the availability of (and discount to be applied to) concession fares
- the availability of discounts for bulk purchases of fares using Bee Card smartcards

Appendix E Significance policy

SIGNIFICANCE POLICY

This policy sets out how to determine the significance of variations to this Plan, in accordance with the requirements of Section 120(4) of the Land Transport Management Act.

APPLICATION

This Plan can be varied at any time. However, public consultation as set out in Sections 125(1) and 125(2) will be required if the variation is found to be significant under this policy.

The approach to consultation will reflect the level of significance of any proposed variation. Consideration will be given to the costs and benefits of any consultative process or procedure, and the extent to which consultation has already taken place.

However, HBRC may undertake targeted consultation on matters affecting specific communities and stakeholders, even if the significance threshold outlined in this policy is not invoked.

GENERAL DETERMINATION OF SIGNIFICANCE

The significance of variations to this Plan will be determined on a case-by-case basis. When determining the significance of a variation, consideration must be given to the extent to which the variation:

- Signals a material change to the planned level of investment in the public transport network
- Affects the consistency of this Plan with the RLTP or any of HBRCs' long-term plans
- Affects residents (variations with a moderate impact on a large number of residents, or variations with a major impact on a small number of residents will have greater significance than those with a minor impact); and
- Affects the integrity of this Plan, including its overall affordability.

SIGNIFICANT AND NON-SIGNIFICANT MATTERS

Matters that will always be considered 'significant' are:

- Any variation that amends this policy on significance; and
- Any variation that introduces a new public transport unit
- Any variation that alters the cost of the provision of public transport services by more than 10% in one financial year.

Matters that will always be considered 'not significant' are:

- Minor editorial and typographical amendments to this Plan; and
- Minor changes to fare levels in accordance with current policy and funding levels
  - Matters that will usually be considered 'not significant' are:
  - A matter that has already been consulted on
  - Minor changes to the description of services following a service review, e.g. changes to the route, frequency and hours of a service that may include a reduction in service levels on a route or routes, but which result in the same, or better, overall level of service across the network
  - Changes to the description of services or grouping of services as a result of an area wide service review, provided that there is no significant increase in cost
  - Any variation that alters the cost of the provision of public transport services in one financial year by less than 10%.

TARGETED CONSULTATION ON NON-SIGNIFICANT VARIATIONS

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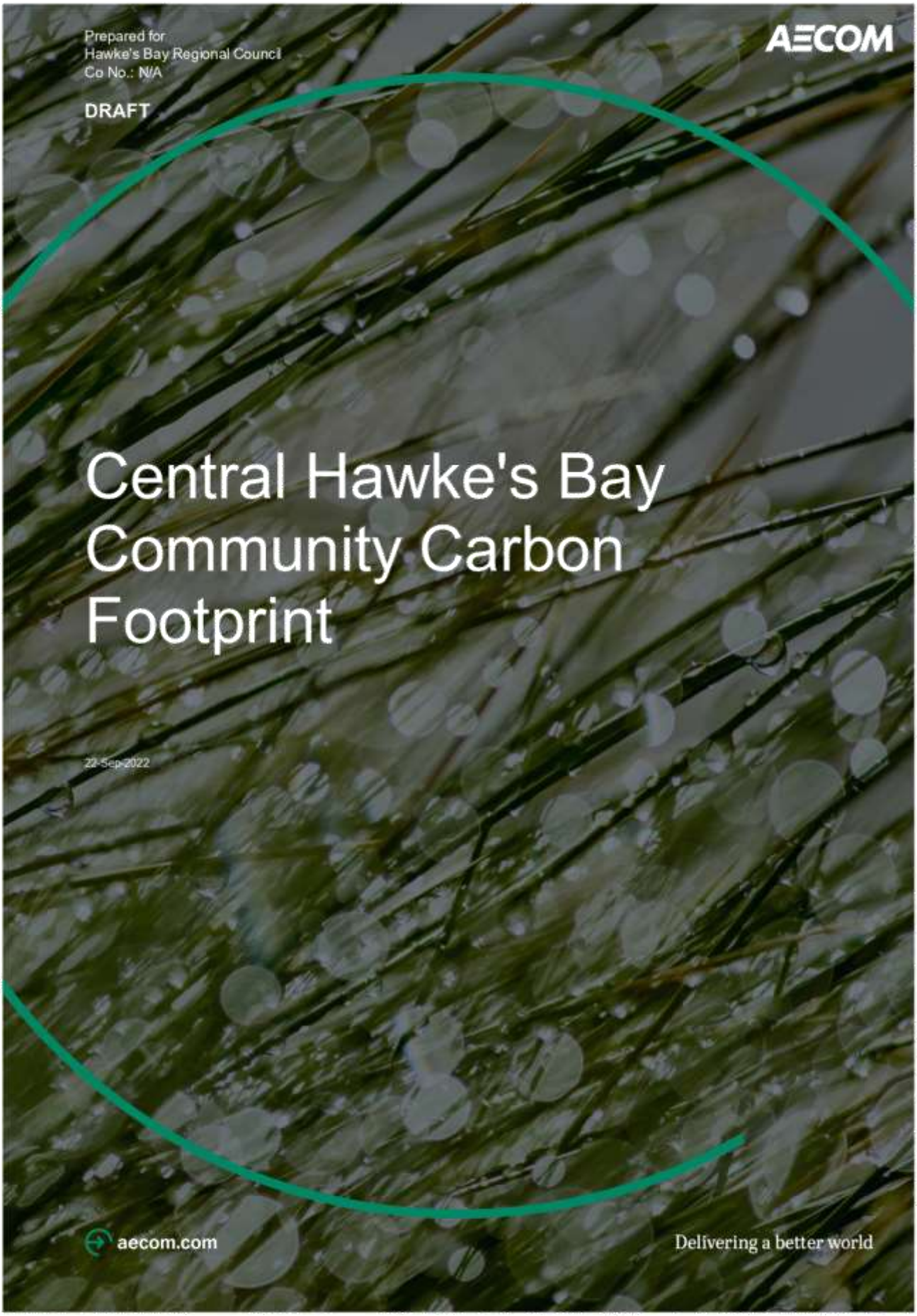
Where HBRC determines that a proposed variation is not significant, HBRC may still undertake targeted consultation as follows:

- Consultation for minor changes in the delivery of public transport services
- Minor changes in service delivery that are required to improve efficiency, such as the addition or deletion of trips and minor route changes that have only a local impact.

In these cases, consultation will generally be undertaken at a local level with the operator/s involved, the relevant territorial authority and passengers who use the services.

OTHER NON-SIGNIFICANT VARIATIONS

Any proposals for changes that affect only a sector of the community or the industry (e.g. a change in Total Mobility provision, or a change to specific vehicle quality standards) will be worked through with those most likely to be affected by the proposed change.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Central Hawke's Bay Community Carbon Footprint

Client: Hawke's Bay Regional Council

Co No.: N/A

Prepared by

AECOM New Zealand Limited
Level 19, 171 Featherston Street, Wellington 6011, PO Box 27277, Wellington 6141, New Zealand
T +64 4 896 6000 F +64 4 896 6001 www.aecom.com

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Quality Information

Document Central Hawke's Bay Community Carbon Footprint

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Prepared by Adam Swithinbank and Tanya Milnes

Reviewed by Anthony Hume

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
1	22-Sept-2022	Final draft	Anthony Hume Team Leader - Sustainability	

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Executive Summary

Greenhouse Gas (GHG) emissions for the Central Hawke's Bay District Territorial Area (that is covered by the Central Hawke's Bay District Council) have been measured using the Global Protocol for Community Scale Greenhouse Gas Emissions Inventory (GPC) methodology. This approach includes emissions from Stationary Energy, Transport, Waste, Industrial Processes and Product Use (IPPU), Agriculture and Forestry sectors. This document reports greenhouse gas emissions produced in or resulting from activity or consumption within the geographic boundaries of the Central Hawke's Bay District Territorial Area for the 2020/21 financial reporting year and examines greenhouse gas emissions produced from 2018/19 to 2020/21.

The Central Hawke's Bay District Territorial Area is referred to hereafter as Central Hawke's Bay for ease. Greenhouse gas emissions are generally reported in this document in units of Carbon Dioxide Equivalents (CO_2e) and are referred to as 'emissions'.

Major findings of the project include:

2020/21 Emissions Footprint

- In the 2020/21 reporting year (1st July 2020 to 30th June 2021), **total gross emissions** in Central Hawke's Bay were 1,309,347 tCO_2e.
- **Agriculture** (e.g. emissions from livestock and crops) is the largest source of emissions, accounting for 87% of Central Hawke's Bay's total gross emissions, with enteric fermentation from livestock accounting for 68% of gross emissions.
- **Transport** (e.g. emissions from road and air travel) is the second largest emitting sector in Central Hawke's Bay, representing 8% of total gross emissions, with petrol and diesel consumption accounting for 7.9% of gross emissions.
- **Stationary Energy** (e.g. consumption of electricity and natural gas), Waste, and IPPU (e.g. refrigerant use) produced the remaining 4% of total gross emissions.
- The **total net emissions** in Central Hawke's Bay were 1,217,462 tCO_2e. Total net emissions includes emissions from forestry which includes both carbon sequestration (carbon captured and stored in plants or soil by forests) and emissions from forest harvesting (e.g., the release of carbon from roots and organic matter following harvesting). In the 2020/21 reporting year, total net emissions were smaller than total gross emissions as within the Forestry sector carbon sequestration (713,503 tCO_2e) was higher emissions from forest harvesting (621,617 tCO_2e).

Changes in Emissions, 2018/19 to 2020/21

- Between 2018/19 and 2020/21, **total gross emissions** in Central Hawke's Bay decreased from 1,395,790 tCO_2e to 1,309,347 tCO_2e, a decrease of 6% (86,443 tCO_2e).
- Over this time the population of the district increased by 5%, resulting in **per capita gross emissions** in Central Hawke's Bay decreasing by 10% between 2018/19 and 2020/21, from 94.5 to 84.6 tCO_2e per person per year.
- Emissions from **Agriculture** decreased by 8%, between 2018/19 and 2020/21 (98,440 tCO_2e), due to a reduction in livestock numbers, particularly of sheep and non-dairy cattle.
- Emissions from **Stationary Energy** increased by 25% between 2018/19 and 2020/21 (6,647 tCO_2e), driven by a 43% increase in electricity consumption emissions (5,428 tCO_2e). This increase in electricity consumption emissions was due to a 1% increase in energy consumption (kWh) and a 41% increase in the emissions intensity of the national electricity grid (tCO_2e/kWh).
- **Transport** emissions increased by 4% between 2018/19 and 2020/21 (4,522 tCO_2e), driven by a 5% increase in on-road fuel emissions (4,536 tCO_2e). Marine freight and air travel emissions reduced during this period, likely reflecting the impact of the COVID-19 pandemic.
- **Forestry** was a net-negative source of emissions due to sequestration being higher than emission from harvesting during this period. Emissions from harvesting decreased by 4% (-22,573 tCO_2e)

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resulting in the net impact of Forestry changing from -64,703 tCO_2e (2018/19) to -91,866 tCO_2e (2020/21).

Figure 1: Central Hawke's Bay 2020/21 Emissions Footprint

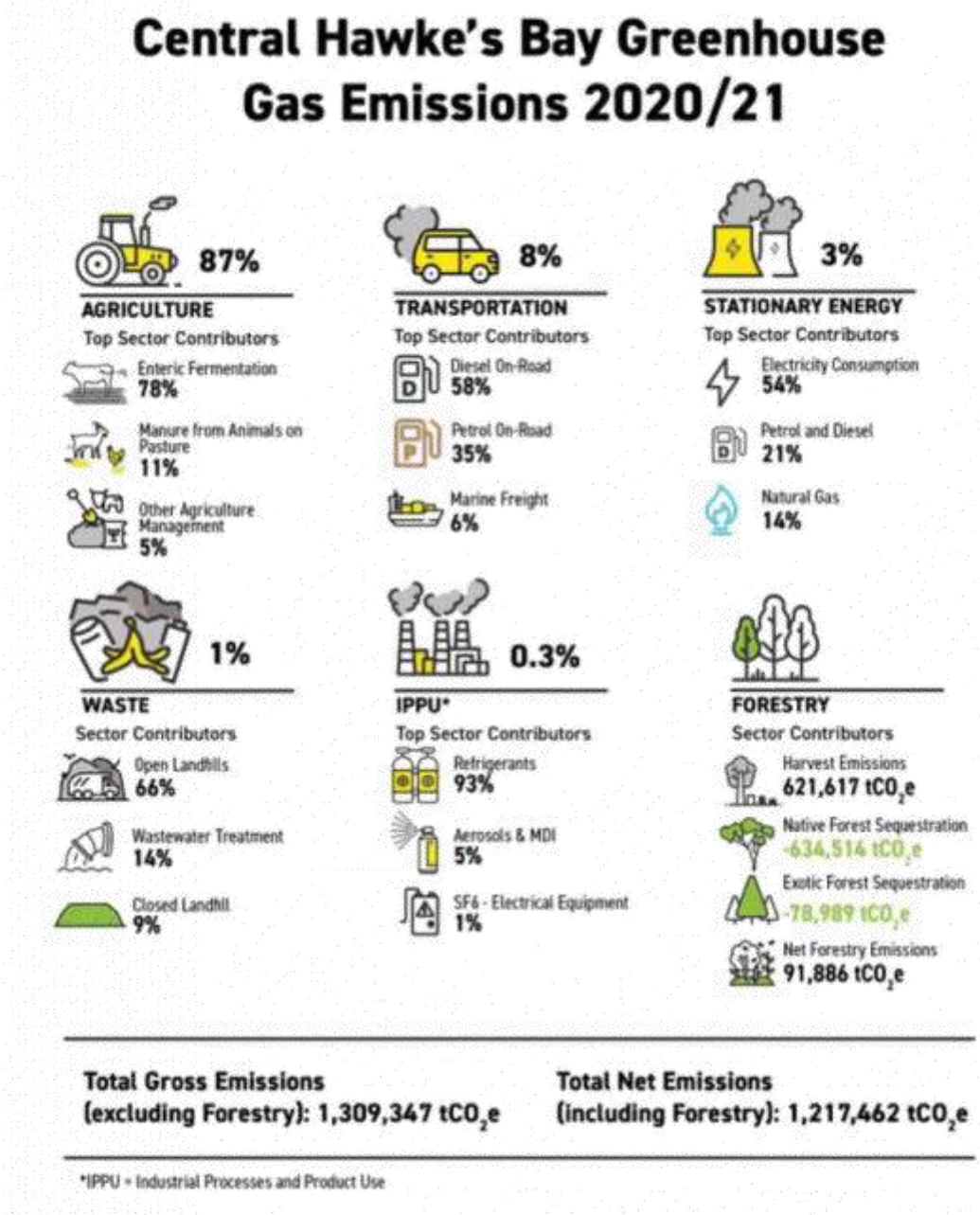

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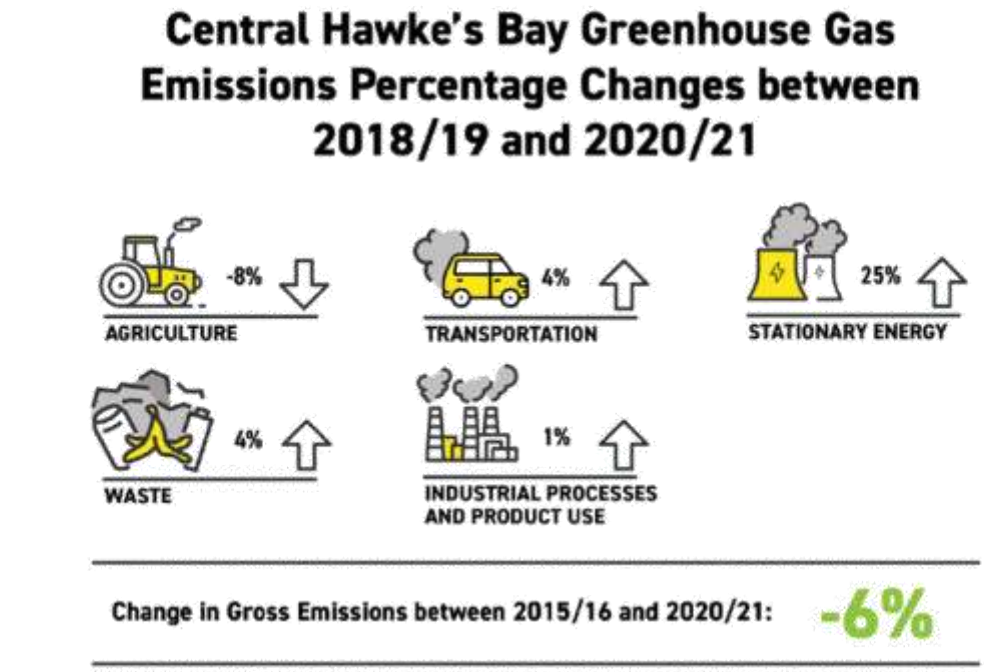
Figure 2: Change in Central Hawke's Bay Emissions Footprint between 2015/16 and 2020/21



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1.0 Introduction

AECOM New Zealand Limited (AECOM) was commissioned by the Hawke's Bay Regional Council to assist in the development of community-scale greenhouse gas (GHG) footprints for the Central Hawke's Bay District Territorial Area for the 2018/19, 2019/20, and 2020/21 financial years. This is part of a wider study to develop community carbon footprints for each district within the Hawke's Bay region. Emissions are reported for the period from 1 July to 30 June for the respective years. The study boundary reported in the following pages incorporates the jurisdiction of the Central Hawke's Bay District Council.

The Central Hawke's Bay District Territorial Area is referred to hereafter as Central Hawke's Bay for ease. Greenhouse gas emissions are generally reported in this document in units of Carbon Dioxide Equivalents (CO_2e) and are referred to as 'emissions'.

2.0 Approach and Limitations

The methodological approach used to calculate emissions follows the Global Protocol for Community Scale Greenhouse Gas Emissions Inventory v1.1 (GPC) published by the World Resources Institute (WRI) 2021. The GPC includes emissions from Stationary Energy, Transport, Waste, Industrial Processes and Product Use (IPPU), Agriculture, and Forestry activities within the district's boundary. The sector calculations for Agriculture, Forestry and Waste are based on Intergovernmental Panel on Climate Change (IPCC) workbooks and guidance for emissions measurement. The sector calculators also use methods consistent with GHG Protocol standards published by the WRI for emissions measurement when needed.

The same methodology has been used for other community scale GHG footprints around New Zealand, (e.g. Wellington, Auckland, Christchurch, Dunedin and the Waikato region) and internationally. The GPC methodology[1] represents international best practice for city and regional level GHG emissions reporting.

This emissions footprint assesses both direct and indirect emissions sources. Direct emissions are production-based and occur within the geographic area (Scope 1 in the GPC reporting framework). Indirect emissions are produced outside the geographic boundary (Scope 2 and 3) but are allocated to the location of consumption. An example of indirect emissions is those associated with the consumption of electricity, which is supplied by the national grid (Scope 2). All other indirect emissions such as cross-boundary travel (e.g. flights) and energy transportation and distribution losses fit into Scope 3.

All major assumptions made during data collection and analysis have been detailed within **Appendix A – Assumptions**. The following aspects are worth noting in reviewing the emissions footprint:

- Emissions are expressed on a carbon dioxide-equivalent basis (CO_2e) including climate change feedback using the 100-year Global Warming Potential (GWP) values[2]. Climate change feedbacks are the climate change impacts from GHGs that are increased as the climate changes. For example, once the Earth begins to warm, it triggers other processes on the surface and in the atmosphere. Current climate change feedback guidance is important to estimate the long-term impacts of GHGs.
- GPC reporting is predominately production-based (as opposed to consumption-based) but includes indirect emissions from energy consumption. Production-based emissions reporting is generally preferred by policy-makers due to robust established methodologies such as the GPC, which enables comparisons between different studies. Production-based approaches exclude globally produced emissions relating to consumption (e.g. embodied emissions relating to products produced elsewhere but consumed within the geographic area such as imported food products, cars, phones, clothes etc.).
- Total emissions are reported as both gross emissions (excluding Forestry) and net emissions (including Forestry).

[1] http://www.ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities
[2] https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf (Table 8.7)

- Emissions for individual main greenhouse gases for each emissions source are provided in the supplementary spreadsheet information supplied with this report.
- Where location specific data were not accessible, information was calculated based on national or regional level data.
- Transport emissions:
  - Transport emissions associated with air travel, rail, and marine fuel were calculated by working out the emissions relating to each journey arriving or departing the area based on data provided by the relevant operators. Emissions for these sources are then split equally between the destination and origin. Emissions relating to a particular point source (e.g. an airport or port) are allocated to the expected users of that source, not just the area that it is located in. For example, in the Hawke's Bay Region, it is expected that all territorial authorities will use the Port of Napier for imported and exported goods, emissions from this source have been allocated to all territorial authorities in the region based on population. It is understood that freight imports moving through the Port of Napier do not exclusively serve the Hawke's Bay Region, and freight exports do not exclusively originate from the Hawke's Bay Region, this should be considered when examining these emissions.
  - All other transport emissions are calculated using the fuel sold in the area (e.g. petrol, diesel, LPG).
- Solid waste emissions:
  - Solid waste emissions from landfill are measured using the IPCC First Order Decay method that covers landfill activity between 1950 and the present day.
  - Emissions are calculated for waste produced within the geographic boundary, even if they are transported outside the boundary to be entered into landfill. Landfill waste for Central Hawke's Bay is understood to be disposed at Farm Road Landfill, Waipukurau.
- Wastewater emissions:
  - Emissions have been calculated based on the local data provided, following IPCC 2019 guidelines. Where data is missing, IPCC and Ministry for the Environment (MfE) figures have been used. Wastewater emissions from both wastewater treatment plants and individual septic tanks have been calculated.
  - Wastewater emissions include those released directly from wastewater treatment, flaring of captured gas and from discharge onto land/water.
- Industrial Processes and Product Use (IPPU) emissions:
  - IPPU emissions are estimated based on data provided in the New Zealand Greenhouse Gas Emissions 1990-2019 report (MfE 2021). Emissions are estimated on a per capita basis applying a national average per person.
- Forestry emissions:
  - This emissions footprint accounts for forest carbon stock changes from afforestation, reforestation, deforestation, and forest management (i.e. it applies land-use accounting conventions under the United Nations Framework Convention on Climate Change rather than the Kyoto Protocol). It treats emissions from harvesting and deforestation as instantaneous rather than accounting for the longer-term emission flows associated with harvested wood products.
  - The emissions footprint considers regenerating (growing) forest areas only. Capture of carbon from the atmosphere is negligible for mature forests that have reached a steady state.

Overall sector data and results for the emissions footprint have been provided to Central Hawke's Bay District Council in calculation table spreadsheets. All assumptions made during data collection and analysis have been detailed within **Appendix A – Assumptions**.

It is important to consider the level of uncertainty associated with the results, particularly given the different datasets used. Depending on data availability, national, regional, and local datasets are used

across the different calculators. At the national level, New Zealand's Greenhouse Gas Inventory shows that for 2018 (the most recent national level inventory) an estimate of gross emissions uncertainty was +/- 9%, whereas a net emissions uncertainty estimate was +/- 12%. These levels of uncertainty should be considered when interpreting the results of this community carbon footprint (MfE, 2020).

StatsNZ Regional Footprint

Due to differences in emission factors and methodology used between the StatsNZ Regional Footprints and this community carbon footprint (based on the GPC requirements and available data), caution should be taken when making comparison of reported emissions. One example of this is where this footprint used updated emission factors for methane and nitrous oxide following guidance from the IPCC and in line with other district and regional level GHG inventories in New Zealand. This difference is especially relevant for the Agriculture sector.

3.0 Community Carbon Footprint for 2020/21

The paragraphs, figures and tables below outline Central Hawke's Bay's greenhouse gas emissions, referred to as 'emissions' in this assessment. This includes Central Hawke's Bay's total emissions, emissions from each sector, and major emissions sources within each sector. The focus of emissions reporting is on gross emissions.

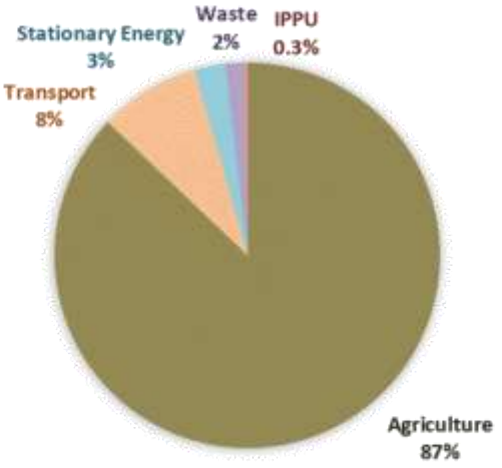
During the 2020/21 reporting period, Central Hawke's Bay emitted **gross** 1,309,347 tCO_2e. Note that gross emissions do not account for Forestry. Agriculture is the largest contributor to total gross emissions for the district.

The population of Central Hawke's Bay in 2020/21 was approximately 15,475 people, resulting in per capita gross emissions of 84.6 tCO_2e/person. Discussion of per capita emissions is limited to when it is useful for comparing emission figures against other territorial authorities. A breakdown of net emissions (i.e. including results from Forestry resources) is reported separately.

Table 1 Total net and gross emissions

Total emissions	tCO_2e
Total Net Emissions (including forestry)	1,217,462
Total Gross emissions (excluding forestry)	1,309,347

Figure 3: Central Hawke's Bay District's total gross GHG emissions split by sector (tCO_2e).



During the 2020/21 reporting period, Central Hawke's Bay emitted **net** 1,217,462 tCO_2e.

Net emissions differ from gross emissions because they include emissions related to forestry activity (harvesting emissions and sequestration) within an area. Forestry emissions are influenced by the cyclical nature of harvesting and planting regimes.

Carbon sequestered by forestry can be viewed as a liability/risk that needs careful consideration. For example, if plantations are not replanted or other land use change occurs to exotic forested areas, then net emissions may rise quickly. Equally, if native forest is not protected from removal, and removal does happen, then net emissions may rise.

The community carbon footprint comprises emissions from six different sectors, summarised below:

3.1 Agriculture

The highest emitting sector in Central Hawke's Bay, Agriculture, emitted 1,141,058 tCO_2e in 2020/21 (Table 2). Agricultural emissions are the result of both livestock and crop farming. Enteric fermentation from livestock produced 78% of Central Hawke's Bay's Agricultural emissions (886,721 tCO_2e). Enteric fermentation GHG emissions are produced by methane (CH_4) released from the digestive process of ruminant animals (e.g. cattle and sheep). The second highest source of agricultural emissions was produced from nitrous oxide (N_2O) released by unmanaged manure from grazing animals on pasture (129,666 tCO_2e or 11% of the Agricultural emissions).

Table 2 Agriculture emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Enteric Fermentation	886,721	67.7%	77.7%
Manure from Grazing Animals	129,666	9.9%	11.4%
Other Agriculture Emissions	54,054	4.1%	4.7%
Atmospheric Deposition	36,933	2.8%	3.2%
Manure Management	22,332	1.7%	2.0%
Agricultural Soils	11,351	0.9%	1.0%
Total	1,141,058	87.1%	**100%**

Livestock were responsible for the majority of the Agriculture sector's GHG emissions (85%, or 1,118,823 tCO_2e) (Table 3). Sheep account for 49% of Agricultural emissions and 42% of gross emissions in Central Hawke's Bay. Non-dairy cattle account for 32% of Agricultural emissions and 28% of gross emissions in Central Hawke's Bay.

Table 3 Agriculture emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Dairy Cattle	172,638	13%	15%
Non-dairy Cattle	361,723	28%	32%
Sheep	555,004	42%	49%
Other livestock	29,458	2%	3%
Fertiliser (other)	22,235	2%	2%
Total	**1,141,058**	**87%**	**100%**

3.2 Transport

Transport produced 110,690 tCO_2e in 2020/21 (8% of Central Hawke's Bay gross total emissions). Table 4 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emission source.

Table 4 Transport emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Diesel	64,491	4.9%	58.3%
Petrol	39,003	3.0%	35.2%
Marine Freight	6,728	0.5%	6.1%
Jet Kerosene	226	<0.1%	0.2%
LPG	133	<0.1%	0.1%
Rail	86	<0.1%	0.1%
Aviation Gas	23	<0.1%	<0.1%
Total	**110,690**	**8%**	**100%**

Most of the Transport emissions can be attributed to diesel and petrol, which produced 64,491 tCO_2e and 39,003 respectively (collectively 94% of the sector's emissions and 8% of total gross emissions). Diesel and petrol transport emissions are broken down into on-road and off-road use. On-road transport consists of all standard transportation vehicles used on roads (including cars, trucks, buses, etc.). Off-road transport consists of all fuel used for the movement of machinery and vehicles off roads (including agricultural tractors and vehicles, forklifts, etc.). On-road transport produced 90,928 tCO_2e (82% of Transport emissions) and Off-road transport produced 12,698 tCO_2e (12% of Transport emissions). An extra breakdown of on-road emissions by vehicle type and class is provided separate to this report.

The next largest emission source for Central Hawke's Bay is marine freight, which contributed to 6% of the sectors emissions (6,728 tCO_2e). Marine freight emissions are the result of freight movements to and from the Port of Napier. Emissions from this source have been divided between all territorial authorities in the Hawke's Bay region based on relative population sizes. It is understood that the imports and exports through this port are not exclusively related to activities in the Hawke's Bay region, however, to ensure that these emissions are reflected in community carbon footprints as per the GPC requirements this approach is appropriate.

The remaining transport emissions are attributed to air travel (jet kerosene and aviation gas), rail freight emissions, and LPG use for transport (e.g. forklifts).

3.3 Stationary Energy

Producing 33,714 tCO_2e in 2020/21, Stationary Energy was Central Hawke's Bay's third highest emitting sector (3% of total gross emissions). Table 5 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emission source.

Table 5 Stationary Energy emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Electricity Consumption	18,154	1.4%	53.8%
Stationary Petrol & Diesel Use	7,136	0.5%	21.2%
Natural Gas	4,578	0.3%	13.6%
Electricity Transmission and Distribution Losses	1,668	0.1%	4.9%
LPG	1,051	0.1%	3.1%
Biofuel / Wood	467	<0.1%	1.4%
Natural Gas Transmission and Distribution Losses	370	<0.1%	1.1%
Coal	290	<0.1%	0.9%
Total:	**33,714**	**3%**	**100%**

Electricity consumption was the cause of 54% of Stationary Energy emissions (18,154 tCO_2e), and 1% of Central Hawke's Bay's total gross emissions (19,822 tCO_2e when including transmission and distribution losses related to consumption). Natural gas consumption accounted for 15% of the Stationary Energy emissions (4,949 tCO_2e) when including transmission and distribution losses. The industrial sector is the primary consumer of electricity and natural gas in Central Hawke's Bay.

Stationary petrol and diesel consumption generated 21% of the sectors emissions (7,136 tCO_2e). Use of LPG, and the burning of coal, biofuels and biogas produced the remaining Stationary Energy emissions.

Stationary Energy demand can also be broken down by fuel type, and by the sector in which it is consumed. Stationary Energy demand is reported for the following sectors: commercial; residential and industrial. However, emissions from petrol and diesel used for Stationary Energy are not able to be broken down by sector.

- Industrial Stationary Energy consumption accounts for 42% of Stationary Energy emissions (14,252 tCO_2e) and 1% of total gross emissions. Industrial Stationary Energy is energy used within all industrial settings (including agriculture, forestry and fishing, mining, food processing, textiles, chemicals, metals, mechanical/electrical equipment and building and construction activities).
- Residential Stationary Energy consumption accounts for 22% of Stationary Energy emissions (7,292 tCO_2e) and 0.6% of total gross emissions. Residential Stationary Energy is energy used in homes (e.g. for heating, lighting, and cooking).
- Commercial Stationary Energy consumption accounts for 15% of Stationary Energy emissions (5,035 tCO_2e) and 0.4% of total gross emissions. Commercial Stationary Energy is energy used in all non-residential and non-industrial settings (e.g. in retail, hospitality, education, and healthcare).
- The remaining 21% of Stationary Energy emissions (7,136 tCO_2e, 0.5% of gross emissions) were produced by diesel and petrol, which were not allocated to the above categories. Stationary Energy uses of diesel and petrol include stationary generators and motors and for heating.

3.4 Waste

Waste originating in Central Hawke's Bay (solid waste and wastewater) produced 19,606 tCO_2e in 2020/21, which comprises 1% of Central Hawke's Bay's total gross emissions. Table 6 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emission source.

Table 6 Waste emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Waste in open landfill sites	12,858	1.0%	65.6%
Wastewater treatment plants	2,723	0.2%	13.9%
Waste in closed landfill sites	1,707	0.1%	8.7%
Individual septic tanks	1,364	0.1%	7.0%
Composting	954	0.1%	4.9%
Total:	**19,606**	**1%**	**100%**

Solid waste produced the bulk of waste emissions (14,565 tCO_2e in 2020/21), making up 74% of total Waste emissions. Solid waste emissions include emissions from open landfills and closed landfills. Open landfill sites contributed 12,858 tCO_2e and emissions from closed landfill sites produced 1,707 tCO_2e in 2020/21. Both open and closed landfills emit landfill (methane) gas from the breakdown of organic materials disposed of in the landfill for many years after waste enters the landfill. However, annual emissions from closed landfill sites will decrease over time as no new waste enters these sites.

Wastewater treatment (treatment plants and individual septic tanks) produced 4,087 tCO_2e making up 21% of total Waste emissions. More than half of households in Central Hawke's Bay are connected to wastewater treatments plants, which produced total emissions of 2,723 tCO_2e. Households connected to individual septic tanks produced 1,364 tCO_2e in wastewater emissions. Due to the production of methane, septic tanks have a higher emissions intensity compared to the wastewater treatments plants in Central Hawke's Bay.

Wastewater treatment tends to be a relatively small emission source compared to solid waste as advanced treatment of wastewater produces low emissions. In contrast, solid waste generates methane gas over many years as organic material enters landfill.

Composting accounts for 5% of total Waste emissions (954 tCO_2e in 2020/21). Waste diverted from landfill for composting in the Hawke's Bay Region includes horticultural, animal waste products, green waste, bark and sawdust.

3.5 Industrial Processes and Product Use (IPPU)

IPPU in Central Hawke's Bay produced 4,280 tCO_2e in 2020/21, contributing 0.3% to Central Hawke's Bay's total gross emissions. This sector includes emissions associated with the consumption of GHGs for refrigerants, foam blowing, fire extinguishers, aerosols, metered dose inhalers and Sulphur Hexafluoride for electrical insulation and equipment production. IPPU emissions do not include energy use for industrial manufacturing, which is included in the relevant Stationary Energy sub-category (e.g. coal, electricity and/or petrol and diesel). These emissions are based on nationally reported IPPU emissions and apportioned based on population due to the difficulty of allocating emissions to particular geographic locations. Addressing IPPU emissions is typically a national policy issue.

There are no known industrial processes (as defined in the GPC requirements) present in Central Hawke's Bay (e.g. aluminium manufacture).

Table 7 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emission source. The most significant contributor to IPPU emissions is the use of refrigerants which produced 93% of IPPU emissions (3,979 tCO_2e).

Table 7 Industrial processes and product use emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Refrigerants and air conditioning	3,979	0.3%	93.0%
Aerosols	223	<0.1%	5.2%
SF6 - Electrical Equipment	44	<0.1%	1.0%
Foam Blowing	19	<0.1%	0.4%
SF6 - Other	9	<0.1%	0.2%
Fire extinguishers	7	<0.1%	0.2%
Total	**4,280**	**0.3%**	**100.0%**

3.6 Forestry

Planting of native forest (e.g. mānuka and kānuka) and exotic forest (e.g. pine), sequesters (captures) carbon from the atmosphere while the trees are growing to maturity. Harvesting of forest emits emissions via the release of carbon from organic matters and soils following harvesting. When sequestration by forests exceeds emissions from harvesting in a particular year, the extra quantity of carbon sequestered by forest reduces total gross emissions for that year. Conversely when emissions from harvesting exceed the amount of carbon sequestered by native and exotic forests, then total gross emissions will increase.

Sequestration in 2020/21 was 713,503 tCO_2e (which was mostly from exotic forestry) while harvesting emissions were 621,617 tCO_2e (based on the assumption that all trees of harvestable-age in this year were harvested). This meant that Forestry in Central Hawke's Bay was a net negative source of emissions in 2020/21 (rather than a positive source of emissions, where harvesting exceeds sequestration). Total Forestry emissions in 2020/21 were -91,886 tCO_2e. It is noted that harvesting of exotic forest can be cyclical in nature where some years will have higher sequestration and some years will have higher harvesting emissions determined by age of forests, commercial operators, and the global market.

Table 8 Forestry emissions by emission source (including sequestration)

Sector / Emissions Source	tCO_2e
Total harvest emissions	621,617
Native forest sequestration	-78,989
Exotic forest sequestration	-634,514
Total	**-91,886**

3.7 Total Gross Emissions by Greenhouse Gas

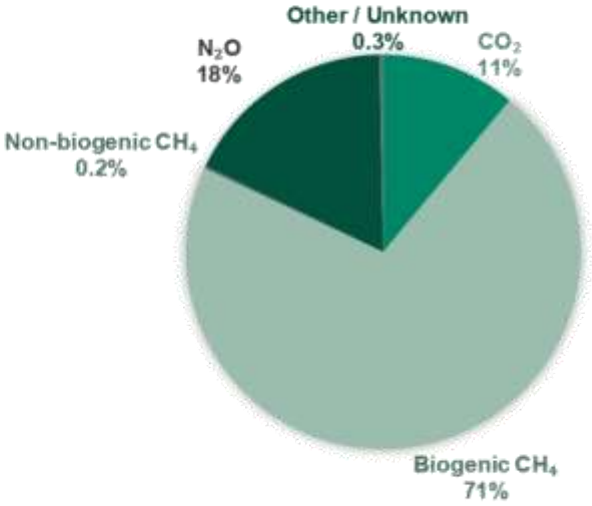
Each greenhouse gas has a different level of impact on climate change, this is accounted for when converting quantities of each gas into units of carbon dioxide equivalent (CO_2e).

Table 9: Central Hawke's Bay total gross emissions, by greenhouse gas

Greenhouse Gas	Tonnes	Tonnes of CO_2e
Carbon Dioxide (CO_2)	145,205	145,205
Biogenic Methane (CH_4)	27,305	928,371
Non-biogenic Methane (CH_4)	69	2,337
Nitrous Oxide (N_2O)	770	229,594
Other / Unknown Gas (in CO_2e)	3,841	3,841
Total	**177,190**	**1,309,347**

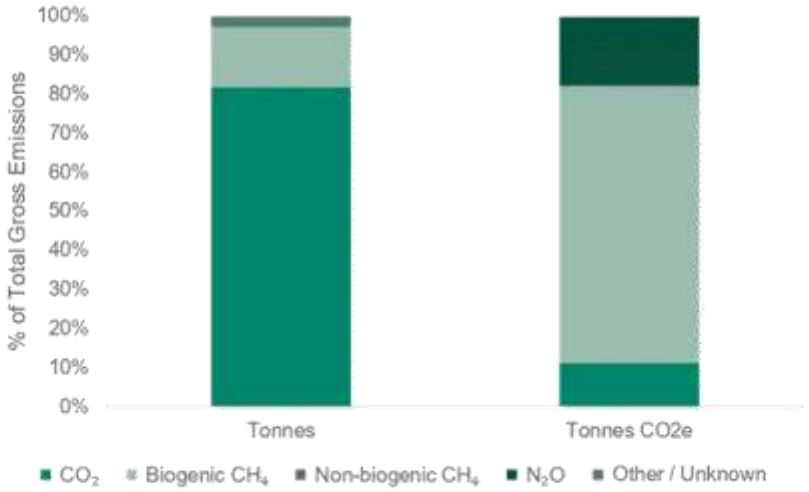
Figure 4 illustrates Central Hawke's Bay's total gross emissions by greenhouse gas in units of carbon dioxide equivalents (CO_2e).

Figure 4: Central Hawke's Bay District's total gross emissions, by greenhouse gas (in tCO_2e)



By far the largest source of emissions in tonnes is carbon dioxide (CO_2) at 145,205 tonnes. Due to the greater global warming impact of methane, methane represents 15% of the total tonnage of GHG emissions from Central Hawke's Bay but represents 71% of CO_2e. Nitrous oxide represents 0.4% of the total tonnage of GHG emissions from Central Hawke's Bay but represents 18% of CO_2e. This effect can be seen in Figure 5.

Figure 5: Central Hawke's Bay District's total gross emissions, by greenhouse gas in tonnes and in tonnes of CO_2e



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Prepared for – Hawke's Bay Regional Council – Co No.: N/A

3.8 Biogenic emissions

Biogenic carbon dioxide and methane emissions are stated in Table 10 and Table 11, respectively.

Biogenic CO_2 emissions are those that result from the combustion of biomass materials that store and sequester CO_2, including materials used to make biofuels (e.g. trees, crops, vegetable oils, or animal fats). Biogenic CO_2 emissions from plants and animals are excluded from gross and net emissions as they are part of the natural carbon cycle.

Table 10: Biogenic CO_2 in Central Hawke's Bay (Excluded from gross emissions)

Biogenic Carbon Dioxide (CO_2) (Excluded from gross emissions)		
Biofuel	15,286	t CO_2
Total Biogenic CO_2	**15,286**	**t CO_2**

Biogenic CH_4 emissions (e.g., produced by farmed cattle via enteric fermentation) are included in gross emissions due to their relatively large impact on global warming relative to biogenic CO_2. Biogenic methane represents 15% of the gross total tonnage of GHG emissions in Central Hawke's Bay but represents 71% of total gross GHG emissions when expressed in CO_2e. This is caused by the higher global warming impact of methane per tonne, compared to carbon dioxide. The total tonnage of each GHG and the contribution of each GHG to total gross emissions when expressed in CO_2e is shown in Table 9.

The importance of biogenic CH_4 is highlighted in NZ's Climate Change Response (Zero Carbon) Amendment Act. The Act includes specific targets to reduce biogenic CH_4 by between 24% and 47% below 2017 levels by 2050, and by 10% below 2017 levels by 2030. More information on the Act is available here: https://www.mfe.govt.nz/climate-change/zero-carbon-amendment-act.

Table 11: Biogenic Methane in Central Hawke's Bay (Included in gross emissions)

Biogenic Methane (CH_4) (Included in gross emissions)		
Enteric Fermentation	26,080	t CH4
Manure Management	657	t CH4
Landfill Gas	428	t CH4
Wastewater Treatment	111	t CH4
Composting	16	t CH4
Biofuel	12	t CH4
Total Biogenic CH_4	**27,305**	**t CH4**

3.9 Territorial Authorities in the Hawke's Bay Region

The Hawke's Bay regional area contains several territorial authorities. Hastings District, Napier City, Central Hawkes Bay District, and Wairoa District are all exclusively within the boundaries of the Hawke's Bay region. Additionally, areas of Taupō District and Rangitīkei District are also part of the Hawke's Bay region. We estimate that 0.1% of Taupō's population and 12% of Taupō's area, and 0.3% of Rangitīkei's population and 14% of Rangitīkei's area are within the Hawke's Bay region.

Figure 6 shows the Hawke's Bay's total gross emissions divided by territorial authority. Figure 7 shows total gross emissions for the territorial authorities in the Hawke's Bay Region, split by sector. Both figures only include the emissions produced within the Hawke's Bay region for Taupō and Rangitīkei.

Hastings is the highest emitting territorial authority in the region, representing 43% of the Hawke's Bay's total gross emissions. Hastings' emissions inventory is predominantly agriculture-related emissions with the next largest emitting territorial authorities; Central Hawke's Bay and Wairoa, also containing significant agricultural emissions. Of the four territorial authorities entirely within the Hawke's Bay region, Napier has the lowest total gross emissions, with emissions mostly from Transport and Stationary Energy. The areas of Taupō and Rangitīkei contribute to 2% of the Hawke's Bay region's total gross emissions, almost entirely from Agriculture.

Figure 6 Hawke's Bay's total gross emissions divided by territorial authority (tCO_2e). *Taupō and Rangitīkei totals only include emissions produced in the Hawke's Bay region.

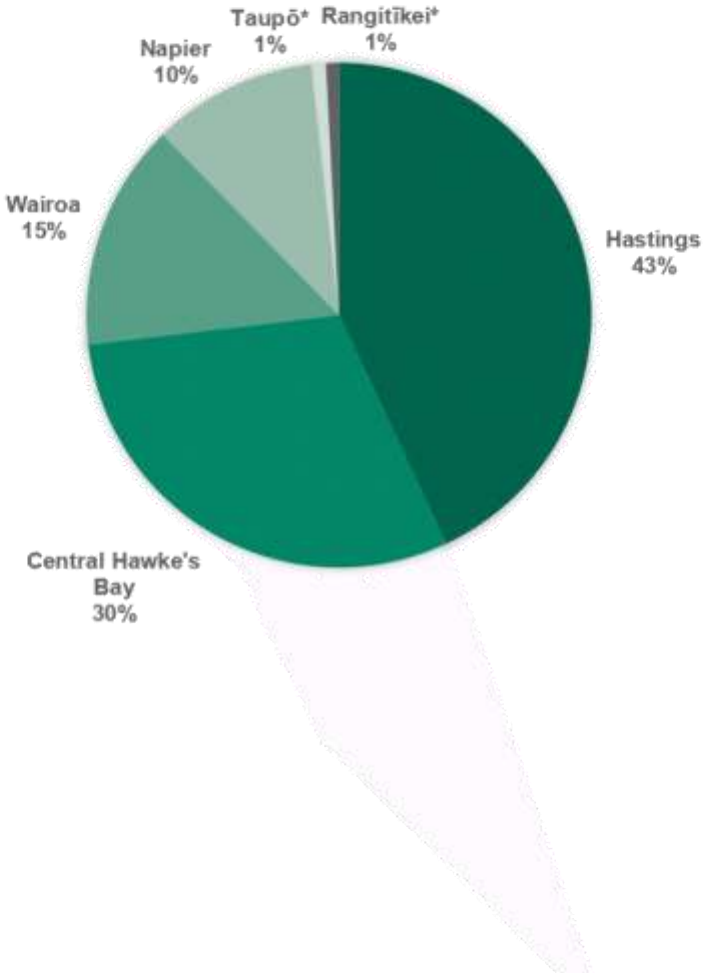
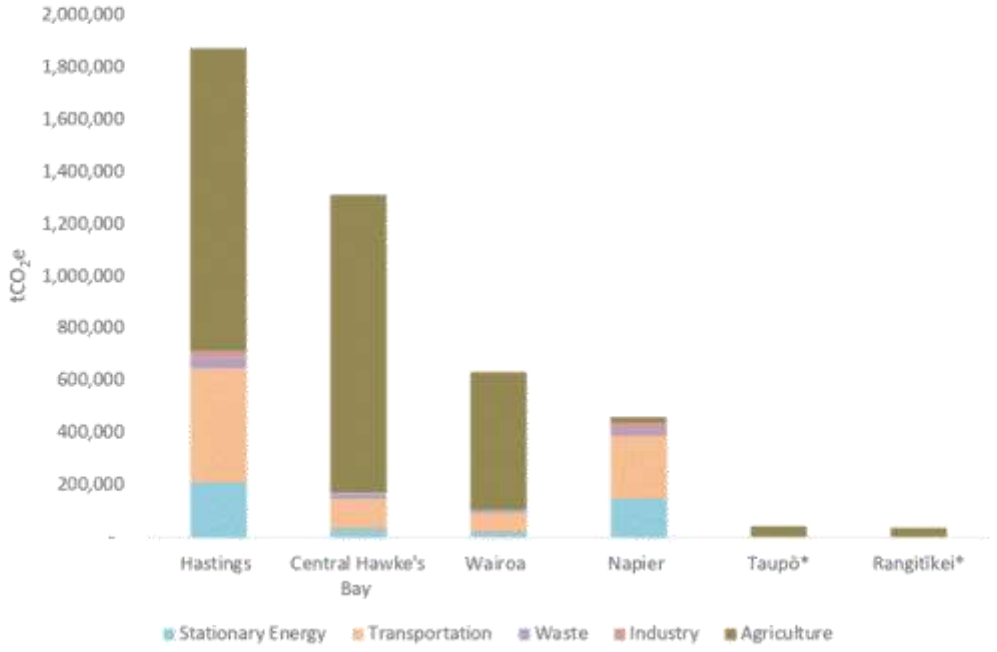


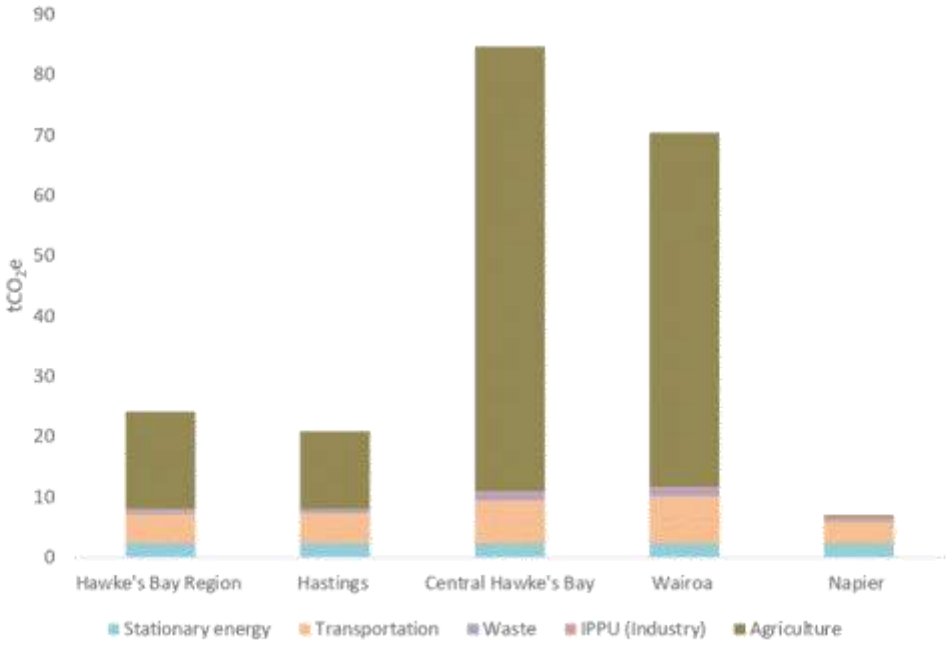
Figure 7 Total gross emissions by territorial authority in the Hawke's Bay region (tCO_2e). *Taupō and Rangitīkei totals only include emissions produced in the Hawke's Bay region.



When comparing emissions inventories from different areas, a per capita figure can be useful because it provides a common reference point to understand the difference in emissions. Figure 8 shows emissions per capita for the region and territorial authorities within the region. Taupō and Rangitīkei are excluded from this figure due to the tiny population and large agriculture within the small area in the Hawke's Bay creating very large per capita emissions (this is not the case for the entire Taupō or Rangitīkei district).

The Hawke's Bay region has a 24.1 tCO_2e/per capita figure for total gross emissions which is higher than the national value of 15.7 tCO_2e/per capita. Napier has the lowest per capita total emissions at 6.9 tCO_2e/per capita. Central Hawke's Bay and Wairoa have the largest per capita total gross emissions at 84.6 tCO_2e/per capita and 70.3 tCO_2e/per capita respectively, both due to high Agriculture emissions in the district. Hastings has the third highest per capita emissions at 20.9 tCO_2e/per capita, similar to that of the region. Notably, Central Hawke's Bay and Wairoa have very high per capita Agriculture emissions and the highest per capita Transport emissions of the four districts entirely within the Hawke's Bay region.

Figure 8 Total gross emissions per capita for the region and territorial authorities within the region (tCO_2e). *Taupō and Rangitīkei areas not included



4.0 Emissions change from 2018/19 to 2020/21

Alongside calculating Central Hawke's Bay's emissions footprint for 2020/21, we have calculated Central Hawke's Bay emissions footprint for 2018/19 and 2019/20. This section displays the results of the 2018/19, 2019/20, and 2020/21 emissions footprints with a focus on gross emissions and documents the change in emissions from 2018/19 to 2020/21.

An analysis of the impact of the COVID-19 pandemic on Central Hawke's Bay's emissions is found in Section 6.0. This section is cautious in examining the interpretation of changes, due to the footprint only assessing one financial year (2018/19) prior to the COVID-19 pandemic disruptions.

Table 12 Change in Central Hawke's Bay total gross and net emissions from 2018/19 to 2020/21

	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Total Net Emissions (including forestry)	1,331,087	1,213,600	1,217,462	-9%
Total Gross Emissions (excluding forestry)	1,395,790	1,277,622	1,309,347	-6%

https://aecom.sharepoint.com/sites/HBRCCCFFY19-FY21/Shared Documents/General/4. Deliverables/220923 Final Reports/HBRC_CommunityCarbonFootprint_2022_CentralHawkesBay_220923_Final.docx
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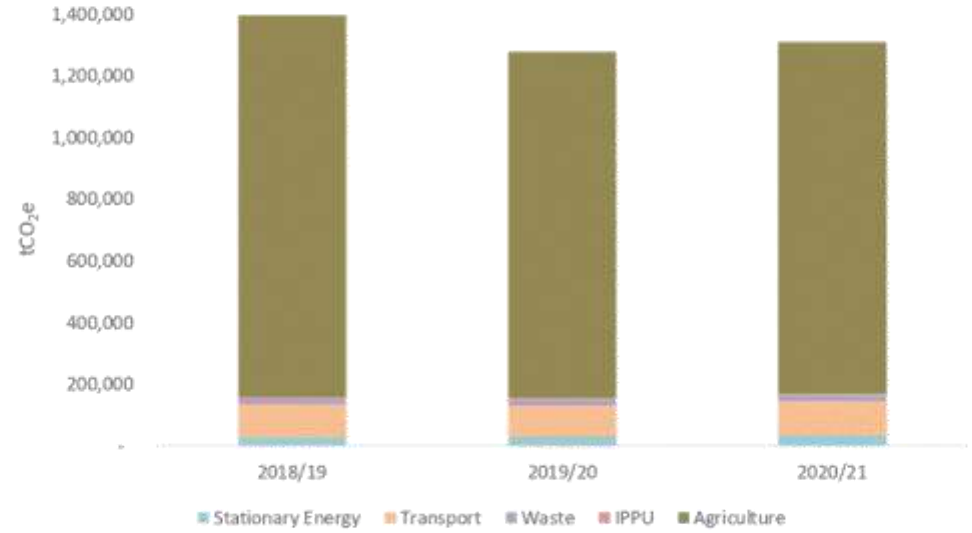
Figure 9 Change in Central Hawke's Bay total gross emissions from 2018/19 to 2020/21



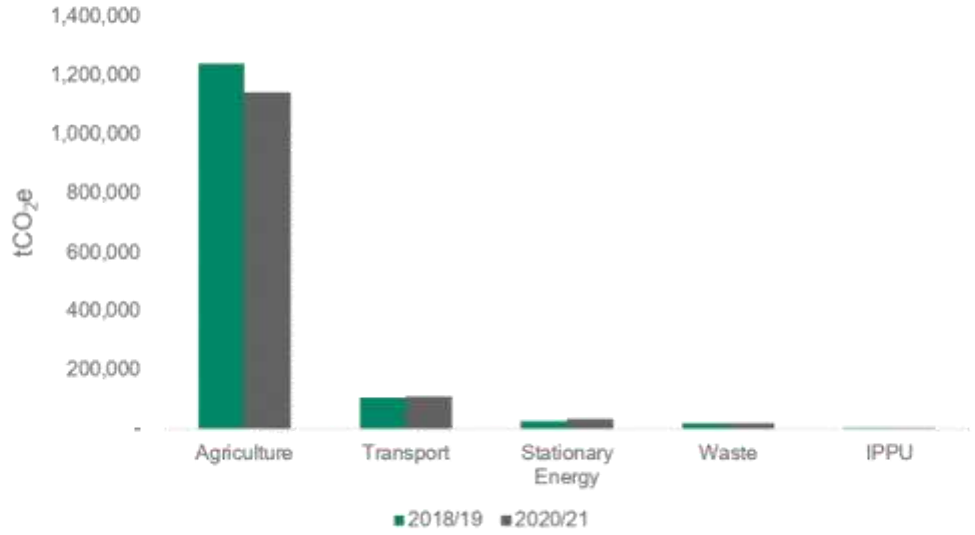
Annual total gross emissions decreased by 6% from 1,395,790 tCO_2e in 2018/19 to 1,309,347 tCO_2e in 2020/21. This was driven by a decrease in Agriculture (number of sheep and non-dairy cattle) and an increase in Stationary Energy (primarily related to the increase in the emissions intensity of the national electricity grid (tCO_2e/kWh).

Total net emissions in Central Hawke's Bay decreased by 9% from 1,331,087 in 2018/19 to 1,217,462 tCO_2e. This decrease was predominantly due to a decrease in annual forest harvesting emissions. This is discussed further below under the 'Forestry' heading.

Whilst total gross emissions decreased by 6%, the population of Central Hawke's Bay grew by 5% during this time. This resulted in a 10% decrease in per capita gross emissions between 2018/19 and 2020/21, from 94.5 to 84.6 tCO_2e per person per year. A discussion of the decoupling of gross emissions from population growth and GDP is found in Section 5.0.

The sections below outline the change in emissions between 2018/19 and 2020/21 for each sector and emissions source, highlighting the changes that have had the largest impact on total gross emissions.

Figure 10 Emissions for each sector of Central Hawke's Bay gross emissions footprint for 2018/19 and 2020/21



4.1 Agriculture

Table 13 Change in Central Hawke's Bay Agriculture emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Enteric Fermentation	958,508	869,607	886,721	-7%
Manure from Grazing Animals	140,596	127,085	129,666	-8%
Other Agriculture Emissions	60,896	54,563	54,054	-11%
Atmospheric Deposition	40,432	36,486	36,933	-9%
Manure Management	24,192	22,565	22,332	-8%
Agricultural Soils	14,873	12,901	11,351	-24%
Total	**1,239,497**	**1,123,206**	**1,141,058**	**-8%**

Agriculture is the most significant contributor to Central Hawke's Bay community carbon footprint. The sector's emissions decreased by 8% between 2018/19 and 2020/21 (98,440 tCO_2e). This decrease is driven by a reduction in total livestock numbers, especially of sheep and non-dairy cattle (see Emissions related to sheep decreased by 58,001 tCO2e due to a reduction in the number of sheep (105,816 sheep). Emissions related to non-dairy cattle decreased by 20,317 tCO2e due to a reduction in the number of non-dairy cattle (10,281 cattle). The number of dairy cattle also reduced, reducing dairy cattle emissions by 12,004 tCO2e.

Table 14).

Emissions related to sheep decreased by 58,001 tCO_2e due to a reduction in the number of sheep (105,816 sheep). Emissions related to non-dairy cattle decreased by 20,317 tCO_2e due to a reduction in the number of non-dairy cattle (10,281 cattle). The number of dairy cattle also reduced, reducing dairy cattle emissions by 12,004 tCO_2e.

Table 14 Change in Hastings livestock numbers from 2018/19 to 2020/21

	Number of animals (2018/19)	Number of animals (2020/21)	Change in number of animals (2018/19 to 2020/21)
Sheep	1,118,349	1,012,533	-105,816
Non-dairy Cattle	151,316	141,035	-10,281
Other livestock	31,131	30,740	-391
Dairy Cattle	45,912	42,501	-3,410
Total livestock	**1,346,707**	**1,226,809**	**-119,898**

Table 15 Change in Central Hawke's Bay's livestock-associated Agriculture emissions from 2018/19 to 2020/21

	2018/19 emissions (tCO_2e)	2020/21 emissions (tCO_2e)	% Change in emissions (2018/19 to 2020/21)
Sheep	613,005	555,004	-9%
Non-dairy Cattle	382,040	361,723	-5%
Dairy Cattle	184,642	172,638	-7%
Other livestock	30,446	29,458	-3%
Total livestock	**1,210,133**	**1,118,123**	**-8%**

4.2 Transport

Table 16 Change in Central Hawke's Bay's Transport emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Diesel	58,849	57,640	64,491	10%
Petrol	39,038	36,533	39,003	-0.1%
Marine Freight	7,721	7,736	6,728	-13%
Jet Kerosene	325	281	226	-31%
LPG	124	126	133	7%
Rail	91	98	86	-5%
Aviation Gas	19	22	23	24%
Total:	**106,168**	**102,436**	**110,690**	**4%**

Transport emissions increased by 4% between 2018/19 and 2020/21 (4,522 tCO_2e). This was driven by a 5% increase in on-road fuel emissions (4,536 tCO_2e).

It is noted that the impact of the COVID-19 pandemic can be seen in Transport emissions where emissions decreased by 4% between 2018/19 and 2019/20 due to reductions in road, marine freight, air

transport fuel use. Aviation emissions continued to reduce in the 2020/21 reporting year, reflective of ongoing COVID-19 impacts to the industry.

4.3 Stationary Energy

Table 17 Change in Central Hawke's Bay Stationary Energy emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Electricity Consumption	12,726	13,602	18,154	43%
Stationary Petrol & Diesel Use	6,537	6,390	7,136	9%
Natural Gas	4,397	4,928	4,578	4%
Electricity Transmission and Distribution Losses	1,111	1,192	1,668	50%
LPG	985	999	1,051	7%
Coal	495	543	290	-41%
Biofuel / Wood	461	463	467	1%
Natural Gas Transmission and Distribution Losses	356	399	370	4%
Total:	**27,067**	**28,516**	**33,714**	**25%**

Emissions from Stationary Energy increased by 25% between 2018/19 and 2020/21 (6,647 tCO_2e). This was driven by a 43% increase in electricity consumption emissions (5,428 tCO_2e). This increase in electricity consumption emissions was due to a 1% increase in energy consumption (kWh) and a 41% increase in the emissions intensity of the national electricity grid (tCO_2e/kWh). The emissions intensity of the national grid has increased in recent years due to the increased use of fossil fuels during years with low hydro electricity generation. Emissions from industrial energy use is the largest driver in the increase in Stationary Energy Emissions (2,555 tCO_2e).

4.4 Waste

Table 18 Change in Central Hawke's Bay Waste emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Open Landfill	12,072	12,483	12,858	7%
Wastewater treatment plants	2,593	2,632	2,723	5%
Closed Landfill	1,910	1,805	1,707	-11%
Individual septic tanks	1,292	1,339	1,364	6%
Composting	954	954	954	-
Total	**18,821**	**19,213**	**19,606**	**4%**

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Waste emissions increased between 2018/19 and 2020/21, by 4% (785 tCO_2e). This change is in line with the growth in the district's population

Emissions from waste in open landfills increased as the volume of waste entering the landfill, and waste recently deposited in landfill reaches peak emissions per year (this is after approximately two years in landfill). Emissions from closed landfills decreased due to no extra waste being added, the existing waste in landfill releases fewer emissions over time. Due to data only being available for one singular year, no change in composting emissions is recorded.

Total wastewater emissions increased by 5% in line with population growth in Central Hawke's Bay. Better data on the number of households connected to centralized wastewater treatment would improve the accuracy of the emissions calculations. Due to the production of methane, septic tanks have a higher emissions intensity compared to a wastewater treatment plant.

4.5 Industrial Processes and Product Use (IPPU)

Table 19 Change in Central Hawke's Bay IPPU emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Refrigerants and air conditioning	3,919	3,945	3,979	2%
Aerosols	247	231	223	-10%
SF6 - Electrical Equipment	39	42	44	12%
Foam Blowing	17	19	19	9%
SF6 - Other	8	8	9	1%
Fire extinguishers	7	7	7	0.4%
Total	**4,237**	**4,251**	**4,280**	**1%**

IPPU emissions increased between 2018/19 and 2020/21, by 1% (43 tCO_2e). The increase in IPPU emissions is mainly caused by an increase in refrigerants and air conditioning. Note that national level data is used for this sector and is portioned out using a population approach; exact emissions for the district are unknown.

4.6 Forestry

Table 20 Change in Central Hawke's Bay Forestry emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Total harvest emissions	644,191	651,458	621,617	-4%
Native forest sequestration	-78,989	-78,989	-78,989	0%
Exotic forest sequestration	-629,905	-636,492	-634,514	1%
Total	**-64,703**	**-64,022**	**-91,886**	**42%**

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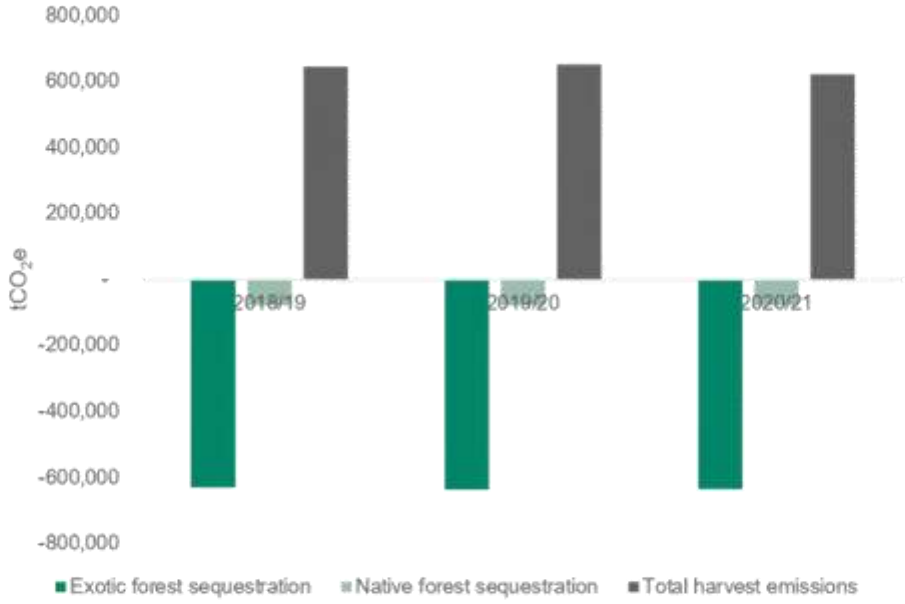
Forestry emissions decreased by 27,182 tCO_2e (42%) between 2018/19 and 2020/21. This decrease was driven by a decrease in total harvest emissions (22,573 tCO_2e) as less exotic forest is harvested. Forestry emissions are influenced by the cyclical nature of harvesting and planting regimes where some years will have higher sequestration and some years will have higher harvesting emissions. This is dependent on age of forests and the demand for lumber and timber. This decrease in Central Hawke's Bay harvesting emissions during this period is reflective a decrease in forestry harvesting across the region. Improved and updated data sources may impact the estimation of emissions from this source in the future. Sequestration by native and exotic forest remained relatively stable during this time.

Figure 11 Forestry sequestration and harvesting emissions from 2018/19 to 2020/21



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5.0 Decoupling of GHG emissions from population growth and GDP

Figure 12 shows the changes in gross emissions when compared to changes in other metrics of interest between 2018/19 and 2020/21. For example, total gross emissions have decreased by 6%, whilst population in Central Hawke's Bay has increased by 5%, resulting in a 10% reduction in total gross emissions per capita. Similarly, Gross Domestic Product (GDP) in Central Hawke's Bay has increased by 2%, resulting in a 8% decrease in the GHG emissions ratio to GDP.

When emissions grow less rapidly than GDP (a measure of income) this process is known as decoupling. The term decoupling is an expression of the desire to mitigate emissions without harming economic wellbeing. A full discussion of decoupling of emissions is beyond the scope of this project. However, the changes in emissions and GDP illustrated in Figure 12 and discussed above, suggest at a high-level decoupling has occurred between 2018/19 and 2020/21.

The exact drivers for the decoupling of emissions from GDP are difficult to pinpoint. New policies, for restructuring the way to meet demand for energy, food, transportation and housing will all contribute. In this case, both direct local actions (e.g. landfill gas reductions) and indirect national trends (e.g. changes to emissions from electricity generation) will have contributed to trends noted.

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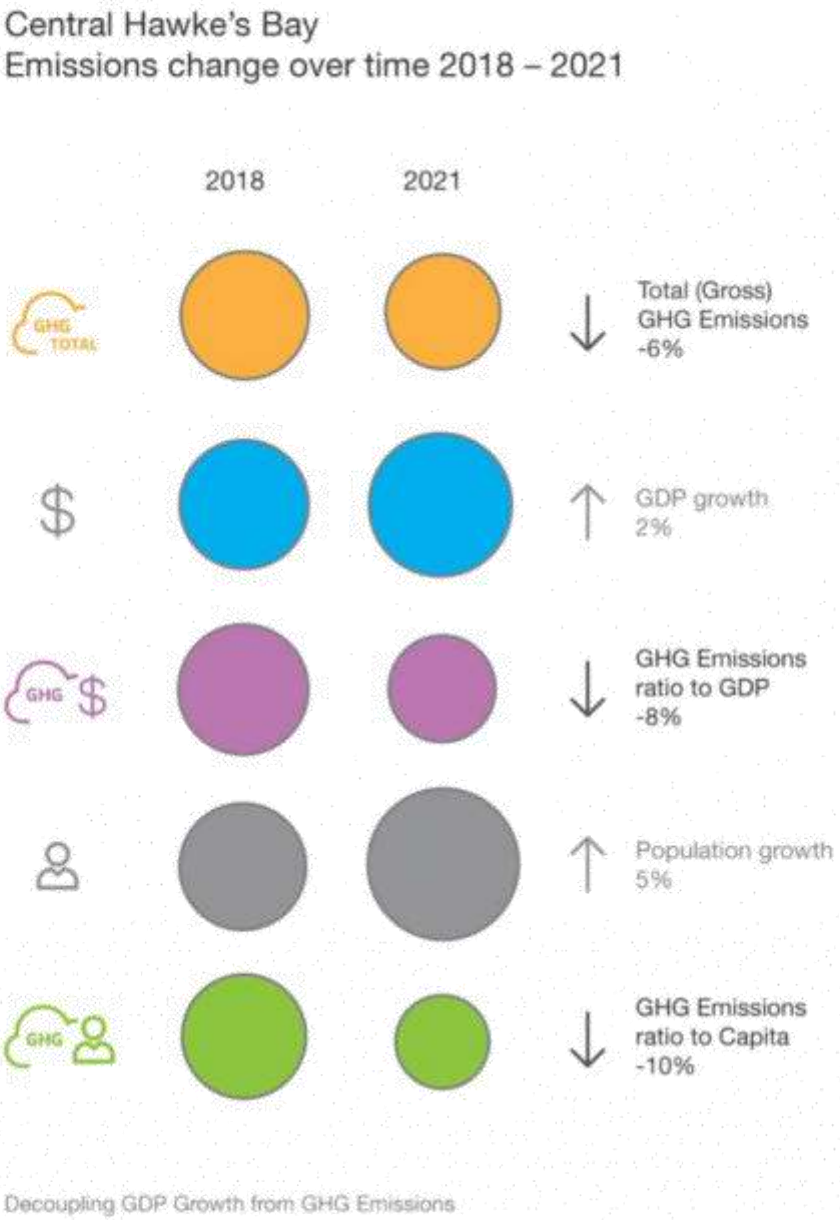
Figure 12 Change in total gross emissions compared to other metrics of interest



6.0 Impact of the COVID-19 pandemic on GHG Emissions

COVID-19 impacted New Zealand and the entire world during 2020 and 2021; causing widespread government-imposed restrictions on businesses and individuals and huge shifts in behaviors and economic markets. Restrictions in New Zealand relating to COVID-19 began in mid-March 2020 with many personal and business restrictions continuing past the end of 2019/20 and throughout 2020/21.[3]

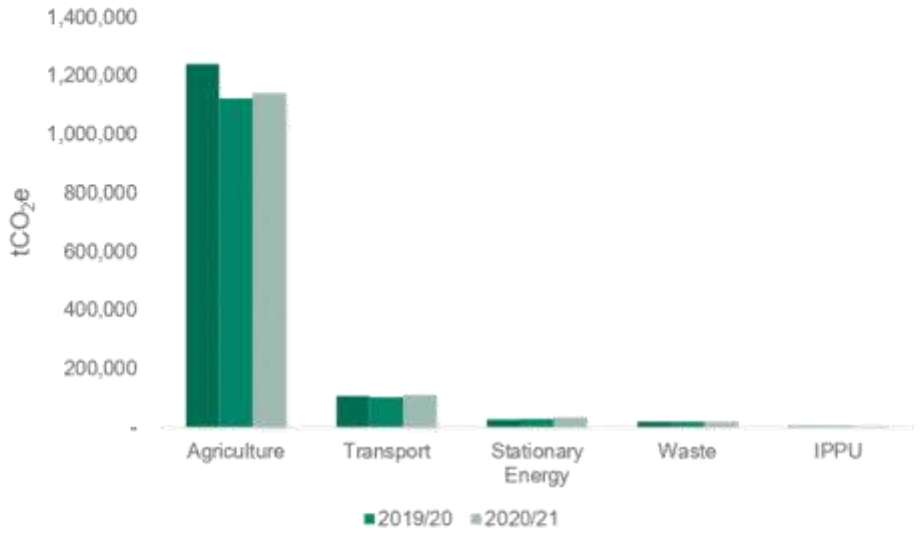
Globally, carbon dioxide emissions from fossil fuels (the largest contributor to greenhouse gas emissions) in 2020 decreased by 7% compared to 2019[4]. Emissions from the transportation sector account for the largest share of this decrease. Surface transport, e.g. car journeys, fell by approximately half at the peak of COVID-19 restrictions in April 2020 (when restrictions were at their maximum, particularly across Europe and the U.S. Globally, emissions recovered to near 2019 levels and are expected to continue to increase.

In New Zealand, national daily carbon dioxide emissions are estimated to have fallen by up to 41% during the level 4 lockdown in April 2020[5]. National gross emissions decreased by 3% from 2018/19 to 2019/20, which was largely driven by a decrease in fuel use in road transport due to COVID-19 pandemic restrictions, a decrease in fuel use in manufacturing industries and construction due to COVID-19 restrictions, and a decrease in fuel use from domestic aviation also due to COVID-19 restrictions.

Total gross emissions in Central Hawke's Bay decreased by 118,168 tCO_2e (8%) between 2018/19 and 2019/20. Total gross emissions then increased by 31,725 tCO_2e (2%) from 2019/20 to 2020/21.

The impact on emissions in different sectors varied. Notably, Transport emissions reduced by 4% between 2018/19 and 2019/20, driven by reduced road and air transport fuel use. Despite changes in Stationary Energy, Agriculture, Waste, and IPPU emissions, these sectors are not judged to have been significantly affected by the COVID-19.

Figure 13 Central Hawke's Bay emissions per sector for 2018/19, 2019/20, and 2020/21 (tCO_2e)



[3] https://covid19.govt.nz/alert-system/history-of-the-covid-19-alert-system/
[4] Pierre Friedlingstein et al. - Global Carbon Budget 2020 (2020)
[5] Corinne Le Quere et al. – Temporary Reduction in Daily Global CO_2 Emissions During the COVID-19 Forced Confinement

7.0 Closing Statement

Central Hawke's Bay GHG emissions footprint provides information for decision-making and action by the council, Central Hawke's Bay stakeholders, and the wider community. We encourage the council to use the results of this study to update current climate actions plans and set emission reduction targets.

The emissions footprint developed for Central Hawke's Bay covers emissions produced in the Stationary Energy, Transport, Waste, IPPU, Agriculture, and Forestry sectors using the GPC reporting framework. Sector-level data allows Central Hawke's Bay to target and work with the sectors that contribute the most emissions to the footprint.

Understanding of the extensive and long-lasting effects of climate change is improving all the time. It is recommended that this emissions footprint be updated regularly (every two or three years) to inform ongoing positive decision making to address climate change issues.

The accuracy of any emissions footprint is limited by the availability, quality, and applicability of data. Areas where data could be improved for future footprints include forestry (forest cover and harvesting), agriculture (especially livestock numbers), wastewater, and on and off-road transport fuel use.

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8.0 Limitations

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Appendix A

Assumptions and Data Sources

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Sector / Category	Assumption and Data Sources
General	
Geographical Boundary	LGNZ local council mapping boundaries have been applied. The emissions footprint for the Hawke's Bay Region covers the entirety of the Hawke's Bay Region (this excludes some of the Rangitikei and Taupō territorial authorities). Emissions footprints for each territorial authority covers the entirety of the territorial authority area.
Population	Population figures are provided by StatsNZ. Financial year populations have been used, these are based on the average population from the two calendar years (e.g. the average of 2018 and 2019 calendar year populations for FY19). The population of Taupo and Rangitikei Districts within the Hawke's Bay geographical boundary has been calculated.
Transport Emissions	
Petrol and Diesel:	Petrol and diesel sales data provided by Napier City Council for Napier, Central Hawkes Bay and Hastings. Combined sales data for Gisborne and Wairoa provided by Gisborne District Council and allocated to a region based on Waka Kotahi emissions data. Sales have been divided between territorial authorities based on the number of kilometres travelled by vehicles on roads (VKT) in each territorial authority. VKT data provided by Waka Kotahi. The division into transport and stationary energy end use (and within transport into on-road and off-road) has been calculated using fuel end use data provided by the Energy Efficiency and Conservation Authority (EECA) from the 2019 database. Biofuel sales information provided directly by the supplier.
Rail Diesel	Emissions from fuel use have been calculated and provided by Kiwi Rail. The following assumptions were made: - Net Weight is product weight only and excludes container tare (the weight of an empty container) - The Net Tonne-Kilometres (NTK) measurement has been used. NTK is the sum of the tonnes carried multiplied by the distance travelled. - National fuel consumption rates have been used to derive litres of fuel for distance. - Type of locomotive engine used, and jurisdiction topography, have not been incorporated in the calculations. The trans-boundary routes were determined, and the number of stops taken along the way derived. The total amount of litres of diesel consumed per route was then split between the departure district, arrival district and any district the freight stopped at along the way. If the freight travelled through but did not stop within a district, no emissions were allocated. This data is subject to commercial confidentiality.
Jet Kerosene (Scheduled Flights) Aviation Gas (General Aviation)	Calculated from information provided by Hawke's Bay Airport. Aviation fuel and jet kerosene fuel volumes were provided and emissions have been calculated using these volumes. Emissions have been divided between territorial authorities based the relative population of each territorial authority.

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Marine Freight	Shipping schedules have been provided by the Port of Napier. Emissions have been calculated based on ship weight and distance from the origin/destination to Napier. This figure does not include fishing vessels, or vessels with destination to be confirmed. Emissions from freight and international shipping are allocated equally between the origin and destination area emissions footprints. It is expected that imports and exports travelling through the Port of Napier service the entire Hawke's Bay Region. Emissions relating to freight and international shipping emissions have been divided between all Hawke's Bay territorial authorities based on population size.
Marine Fuel (Local)	Non-freight marine fuel use has not been included in this study. Fuel use by Port of Napier-controlled vessels has not been included due to a lack of available information. Most private marine vessels use fuel purchased at vehicle fuel stations. Petrol and diesel used in private marine vessels is included in off-road transportation.
LPG Consumption	North Island LPG sales data (tonnes) has been provided by the LPG Association. 'Auto' and 'Forklift' sales represent transport uses of LPG. Sales have been divided between territorial authorities on a per capita basis.
Stationary Energy Emissions	
Electricity Demand	Electricity demand has been calculated using grid exit point (GXP) data from the EMI website (www.emi.ea.govt.nz). Reconciled demand has been used as per EMI's confirmation. The territorial authorities serviced by each GXP have been confirmed by the respective electricity suppliers. The breakdown into sectors (Residential, Commercial, and Industrial) is based on NZ average consumption per sector as per Ministry for the Environment (MfE) data.
Electricity Generation	Electricity generation has been calculated using data from the EMI website (www.emi.ea.govt.nz). Small electricity generation has not been included in this data (e.g. domestic solar generation). This figure only includes electricity that is connected to the national electricity grid, direct users of electricity are not included.
Coal Consumption	National coal consumption data has been provided by MBIE. Regional industrial coal data has been provided by EECA. National residential and commercial coal consumption has been divided between territorial authorities on a per capita basis. Regional industrial coal consumption has been divided between territorial authorities on a per capita basis.
Coal Production and Fugitive Emissions	Not Calculated: There are no active coal mines within the region.
Biofuel Consumption	National biofuel consumption data has been provided by the Ministry for Business, Innovation and Employment (MBIE). Biofuel consumption has been divided between territorial authorities on a per capita basis. Biofuel emissions are broken down into Biogenic emissions (CO_2) and Non-Biogenic emissions (CH_4 and N_2O)

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LPG Consumption	North Island LPG sales data (tonnes) has been provided by the LPG Association. 'Auto' and 'Forklift' sales represent transport uses of LPG. All other sales represent stationary energy uses of LPG. Sales have been divided between territorial authorities on a per capita basis. The breakdown into sectors (Residential, Commercial, and Industrial) is based on NZ average consumption per sector as per MfE data.
Natural Gas Consumption	Natural gas consumption data has been provided by FirstGas. Territorial Authorities supplied by gas from each Point of Connection (POC) have been confirmed by FirstGas. Natural gas consumption has been split into residential, commercial, and industrial consumption based on information provided by PowerCo and national statistics from MBIE. Some POCs supply gas to particular industrial users exclusively, these have been taken into account.
Oil and Gas Fugitive Emissions	Not Calculated: There are no gas or oil processing plants within the region.
Agricultural Emissions	
General	Territorial authority livestock numbers and fertiliser data taken from the Agricultural Census (StatsNZ). The last territorial authority census was in 2017. Regional agricultural data from StatsNZ (2021) has been used to estimate the change in livestock and fertiliser use since 2017. Territorial authority land-use data provided by HBRC covering horticulture land-use.
Solid Waste Emissions	
Waste in Landfill	Landfill waste volume and end location information has been provided by the respective council departments. Where information is not available, waste volumes have been estimated based on historical national data on a per capita basis. Emissions are allocated to territorial authorities based on where the waste was produced, even if the waste is disposed in landfill outside the territorial authority.
Wastewater Emissions	
Wastewater Volume and Treatment Systems	Information on treated wastewater, and treatment plants has been provided by the respective council departments. Where information is not available, reasonable assumptions have been made and the WaterNZ database has been consulted. The population connected to septic tank systems have been estimated by the respective council departments. Where the population covered by Wastewater treatment plants and septic tanks does not account for the entire population, the remaining population is assigned to septic tanks. Emissions are allocated to territorial authorities based on where the wastewater was produced, even if the wastewater is treated outside the territorial authority.
Industrial Emissions	
Industrial processes	It is assumed that there are no significant non-energy related emissions of greenhouse gasses from industrial processes in the Region (e.g. aluminium manufacture).
Industrial Product Use	National data covering industrial product use (e.g. fire extinguishers, refrigerants) has been provided by the MfE. Emissions have been allocated to territorial authorities on a per capita basis.

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Forestry Emissions	
Exotic Forestry Harvested	Harvested forestry, and forest cover information for each territorial authority has been derived from Landcare Research data. It has been assumed that only 70% of the tree is removed as roundwood and that the above ground tree makes up approximately 74% of the total carbon stored.
Exotic Forest	Exotic forest land area for each territorial authority has been provided by Landcare Research.
Emission Factors	
General	All emission factors have detailed source information in the calculation tables within which they are used. Where possible, the most up to date, NZ-specific EFs have been applied. AR5 Global Warming Potential (GWP) figures for greenhouse gases have been used accounting for climate change feedbacks.

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Prepared by

AECOM New Zealand Limited
Level 19, 171 Featherston Street, Wellington 6011, PO Box 27277, Wellington 6141, New Zealand
T +64 4 896 6000 F +64 4 896 6001 www.aecom.com

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Quality Information

Document Hastings Community Carbon Footprint

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Prepared by Adam Swithinbank and Tanya Milnes

Reviewed by Anthony Hume

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
1	23-Sept-2022	Final draft	Anthony Hume Team Leader - Sustainability	

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Executive Summary

Greenhouse Gas (GHG) emissions for the Hastings District Territorial Area (that is covered by the Hastings District Council) have been measured using the Global Protocol for Community Scale Greenhouse Gas Emissions Inventory (GPC) methodology. This approach includes emissions from Stationary Energy, Transport, Waste, Industrial Processes and Product Use (IPPU), Agriculture and Forestry sectors. This document reports greenhouse gas emissions produced in or resulting from activity or consumption within the geographic boundaries of the Hastings District Territorial Area for the 2020/21 financial reporting year and examines greenhouse gas emissions produced from 2018/19 to 2020/21.

The Hastings District Territorial Area is referred to hereafter as Hastings for ease. Greenhouse gas emissions are generally reported in this document in units of Carbon Dioxide Equivalents (CO_2e) and are referred to as 'emissions'.

Major findings of the project include:

2020/21 Emissions Footprint

- In the 2020/21 reporting year (1st July 2020 to 30th June 2021), **total gross emissions** in Hastings were 1,869,526 tCO_2e.
- **Agriculture** (e.g. emissions from livestock and crops) is the largest source of emissions, accounting for 62% of Hastings's total gross emissions, with enteric fermentation from livestock accounting for 48% of gross emissions.
- **Transport** (e.g. emissions from road and air travel) is the second largest emitting sector in Hastings, representing 23% of total gross emissions, with petrol and diesel consumption accounting for 21% of gross emissions.
- **Stationary Energy** (e.g. consumption of electricity and natural gas) is the third highest emitting sector in the region, producing 11% of total gross emissions.
- The **total net emissions** in Hastings were 552,948 tCO_2e. The total net emissions include emissions from forestry which includes both carbon sequestration (carbon captured and stored in plants or soil by forests) and emissions from forest harvesting (e.g., the release of carbon from roots and organic matter following harvesting). In the 2020/21 reporting year, total net emissions were smaller than total gross emissions as carbon sequestration (2,710,299 tCO_2e) was higher than emissions from forest harvesting (1,393,722 tCO_2e).

Changes in Emissions, 2018/19 to 2020/21

- Between 2018/19 and 2020/21, **total gross emissions** in Hastings decreased from 1,911,938 tCO_2e to 1,869,526 tCO_2e, a decrease of 2% (42,412 tCO_2e).
- Over this time the population of the district increased by 5%, resulting in **per capita gross emissions** in Hastings decreasing by 7% between 2018/19 and 2020/21, from 22.4 to 20.9 tCO_2e per person per year.
- Emissions from **Agriculture** decreased by 8%, between 2018/19 and 2020/21 (95,257 tCO_2e), due to a reduction in livestock numbers, particularly of sheep and non-dairy cattle.
- Emissions from **Stationary Energy** increased by 21% between 2018/19 and 2020/21 (36,479 tCO_2e), driven by a 47% increase in electricity consumption emissions (28,495 tCO_2e). This increase in electricity consumption emissions was due to a 4% increase in energy consumption (kWh) and a 41% increase in the emissions intensity of the national electricity grid (tCO_2e/kWh).
- **Transport** emissions increased by 3% between 2018/19 and 2020/21 (14,639 tCO_2e), driven by a 5% increase in on-road fuel emissions (16,826 tCO_2e). Marine freight and air travel emissions reduced during this period, likely due to the impact of the COVID-19 pandemic.
- Emissions from **Waste** increased by 4% between 2018/19 and 2020/21 (1,425 tCO_2e).

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- **Forestry** was a net-negative source of emissions this period. Emissions from harvesting decreased by 25% (-474,120 tCO_2e) resulting in the net impact of Forestry changing from -798,819 tCO_2e (2018/19) to -1,316,577 tCO_2e (2020/21).

Figure 1: Hastings 2020/21 Emissions Footprint

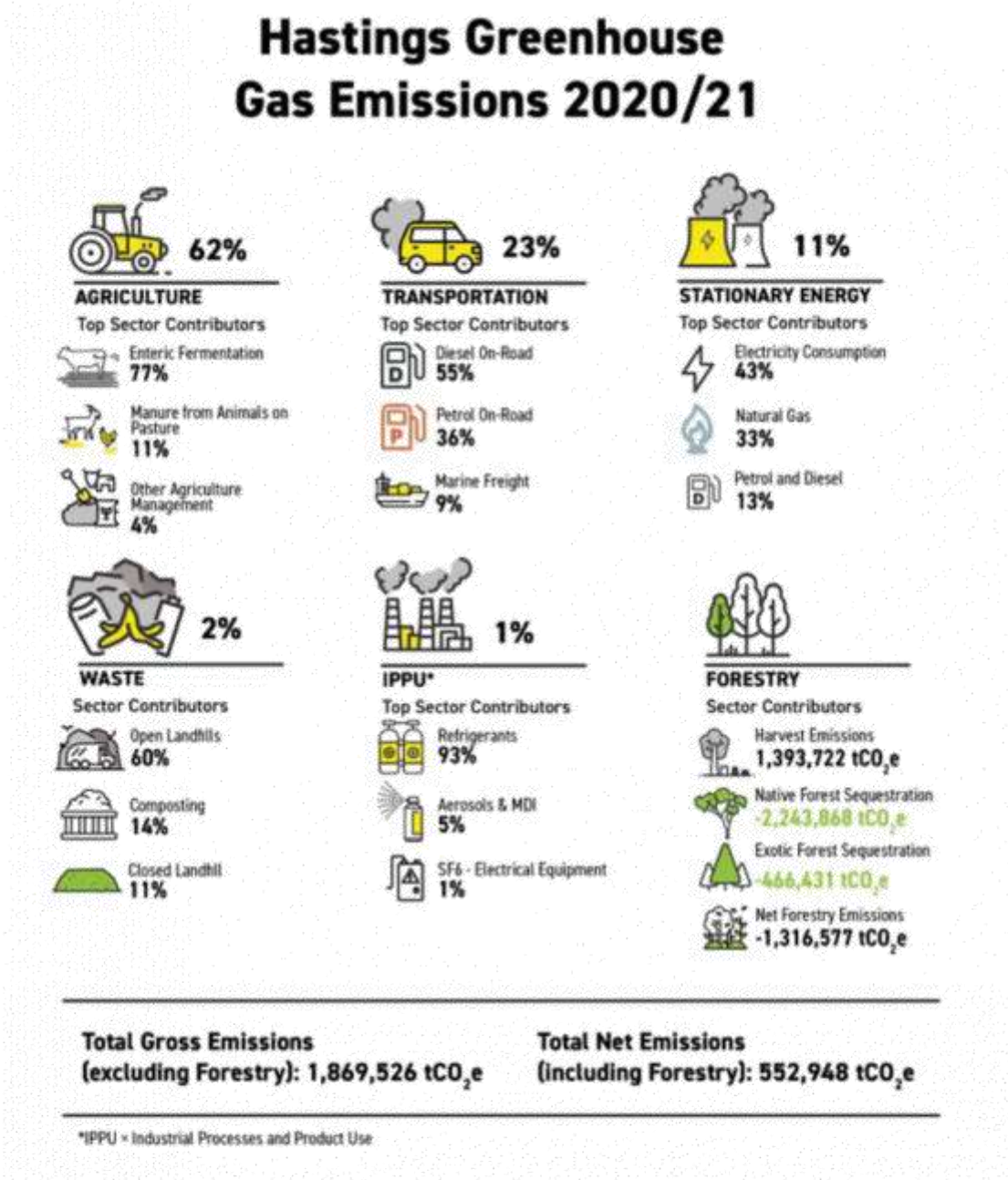

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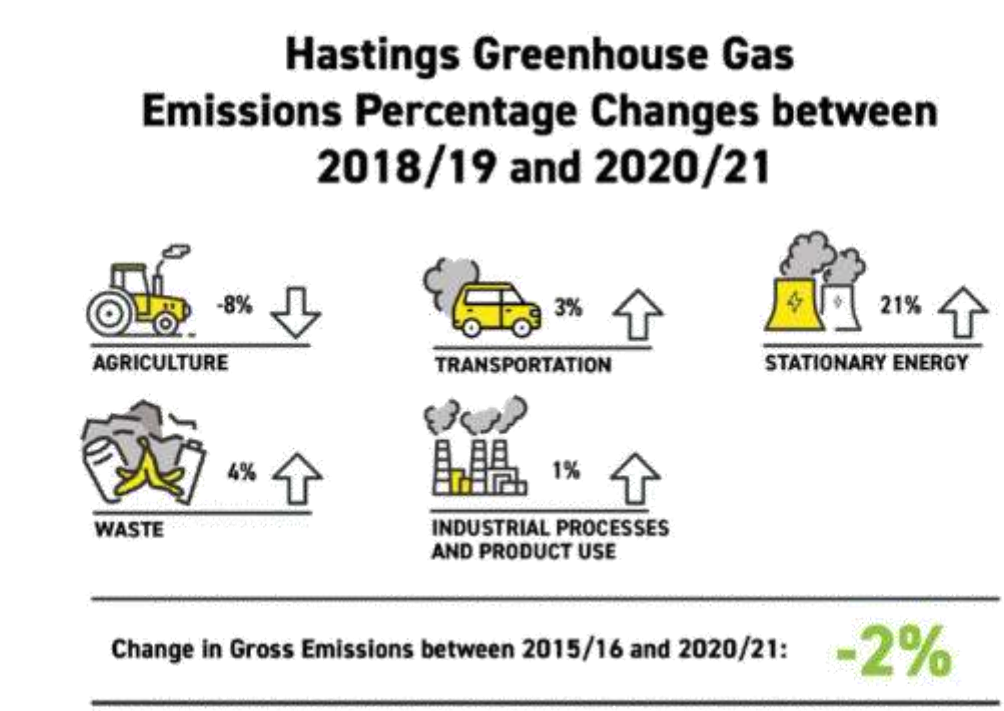
Figure 2: Change in Hastings Emissions Footprint between 2015/16 and 2020/21



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1.0 Introduction

AECOM New Zealand Limited (AECOM) was commissioned by the Hawke's Bay Regional Council to assist in the development of community-scale greenhouse gas (GHG) footprints for the Hastings District Territorial Area for the 2018/19, 2019/20, and 2020/21 financial years. This is part of a wider study to develop community carbon footprints for each district within the Hawke's Bay region. Emissions are reported for the period from 1 July to 30 June for the respective years. The study boundary reported in the following pages incorporates the jurisdiction of the Hastings District Council.

The Hastings District Territorial Area is referred to hereafter as Hastings for ease. Greenhouse gas emissions are generally reported in this document in units of Carbon Dioxide Equivalents (CO_2e) and are referred to as 'emissions'.

2.0 Approach and Limitations

The methodological approach used to calculate emissions follows the Global Protocol for Community Scale Greenhouse Gas Emissions Inventory v1.1 (GPC) published by the World Resources Institute (WRI) 2021. The GPC includes emissions from Stationary Energy, Transport, Waste, Industrial Processes and Product Use (IPPU), Agriculture, and Forestry activities within the district's boundary. The sector calculations for Agriculture, Forestry and Waste are based on Intergovernmental Panel on Climate Change (IPCC) workbooks and guidance for emissions measurement. The sector calculators also use methods consistent with GHG Protocol standards published by the WRI for emissions measurement when needed.

The same methodology has been used for other community scale GHG footprints around New Zealand, (e.g. Wellington, Auckland, Christchurch, Dunedin and the Waikato region) and internationally. The GPC methodology[1] represents international best practice for city and regional level GHG emissions reporting.

This emissions footprint assesses both direct and indirect emissions sources. Direct emissions are production-based and occur within the geographic area (Scope 1 in the GPC reporting framework). Indirect emissions are produced outside the geographic boundary (Scope 2 and 3) but are allocated to the location of consumption. An example of indirect emissions is those associated with the consumption of electricity, which is supplied by the national grid (Scope 2). All other indirect emissions such as cross-boundary travel (e.g. flights) and energy transportation and distribution losses fit into Scope 3.

All major assumptions made during data collection and analysis have been detailed within **Appendix A – Assumptions**. The following aspects are worth noting in reviewing the emissions footprint:

- Emissions are expressed on a carbon dioxide-equivalent basis (CO_2e) including climate change feedback using the 100-year Global Warming Potential (GWP) values[2]. Climate change feedbacks are the climate change impacts from GHGs that are increased as the climate changes. For example, once the Earth begins to warm, it triggers other processes on the surface and in the atmosphere. Current climate change feedback guidance is important to estimate the long-term impacts of GHGs.
- GPC reporting is predominately production-based (as opposed to consumption-based) but includes indirect emissions from energy consumption. Production-based emissions reporting is generally preferred by policy-makers due to robust established methodologies such as the GPC, which enables comparisons between different studies. Production-based approaches exclude globally produced emissions relating to consumption (e.g. embodied emissions relating to products produced elsewhere but consumed within the geographic area such as imported food products, cars, phones, clothes etc.).
- Total emissions are reported as both gross emissions (excluding Forestry) and net emissions (including Forestry).

[1] http://www.ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities
[2] https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf (Table 8.7)

- Emissions for individual main greenhouse gases for each emissions source are provided in the supplementary spreadsheet information supplied with this report.
- Where location specific data were not accessible, information was calculated based on national or regional level data.
- Transport emissions:
  - Transport emissions associated with air travel, rail, and marine fuel were calculated by working out the emissions relating to each journey arriving or departing the area based on data provided by the relevant operators. Emissions for these sources are then split equally between the destination and origin. Emissions relating to a particular point source (e.g. an airport or port) are allocated to the expected users of that source, not just the area that it is located in. For example, in the Hawke's Bay Region, it is expected that all territorial authorities will use the Port of Napier for imported and exported goods, emissions from this source have been allocated to all territorial authorities in the region based on population. It is understood that freight imports moving through the Port of Napier do not exclusively serve the Hawke's Bay Region, and freight exports do not exclusively originate from the Hawke's Bay Region, this should be considered when examining these emissions.
  - All other transport emissions are calculated using the fuel sold in the area (e.g. petrol, diesel, LPG).
- Solid waste emissions:
  - Solid waste emissions from landfill are measured using the IPCC First Order Decay method that covers landfill activity between 1950 and the present day.
  - Emissions are calculated for waste produced within the geographic boundary, even if they are transported outside the boundary to be entered into landfill. Landfill waste for Hastings is disposed at Omarunui Landfill, jointly owned by the Hastings District Council and Napier City Council. This landfill is located within the Hastings geographic boundary.
- Wastewater emissions:
  - Emissions have been calculated based on the local data provided, following IPCC 2019 guidelines. Where data is missing, IPCC and Ministry for the Environment (MfE) figures have been used. Wastewater emissions from both wastewater treatment plants and individual septic tanks have been calculated.
  - Wastewater emissions include those released directly from wastewater treatment, flaring of captured gas and from discharge onto land/water.
- Industrial Processes and Product Use (IPPU) emissions:
  - IPPU emissions are estimated based on data provided in the New Zealand Greenhouse Gas Emissions 1990-2019 report (MfE 2021). Emissions are estimated on a per capita basis applying a national average per person.
- Forestry emissions:
  - This emissions footprint accounts for forest carbon stock changes from afforestation, reforestation, deforestation, and forest management (i.e. it applies land-use accounting conventions under the United Nations Framework Convention on Climate Change rather than the Kyoto Protocol). It treats emissions from harvesting and deforestation as instantaneous rather than accounting for the longer-term emission flows associated with harvested wood products.
  - The emissions footprint considers regenerating (growing) forest areas only. Capture of carbon from the atmosphere is negligible for mature forests that have reached a steady state.

Overall sector data and results for the emissions footprint have been provided to Hastings District Council in calculation table spreadsheets. All assumptions made during data collection and analysis have been detailed within **Appendix A – Assumptions**.

It is important to consider the level of uncertainty associated with the results, particularly given the different datasets used. Depending on data availability, national, regional, and local datasets are used across the different calculators. At the national level, New Zealand's Greenhouse Gas Inventory shows that for 2018 (the most recent national level inventory) an estimate of gross emissions uncertainty was +/- 9%, whereas a net emissions uncertainty estimate was +/- 12%. These levels of uncertainty should be considered when interpreting the results of this community carbon footprint (MfE, 2020).

StatsNZ Regional Footprint

Due to differences in emission factors and methodology used between the StatsNZ Regional Footprints and this community carbon footprint (based on the GPC requirements and available data), caution should be taken when making comparison of reported emissions. One example of this is where this footprint used updated emission factors for methane and nitrous oxide following guidance from the IPCC and in line with other district and regional level GHG inventories in New Zealand. This difference is especially relevant for the Agriculture sector.

3.0 Community Carbon Footprint for 2020/21

The paragraphs, figures and tables below outline Hastings greenhouse gas emissions, referred to as 'emissions' in this assessment. This includes Hastings total emissions, emissions from each sector, and major emissions sources within each sector. The focus of emissions reporting is on gross emissions.

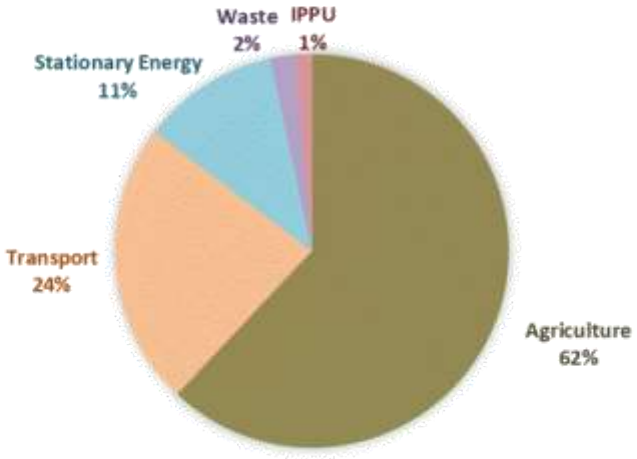
During the 2020/21 reporting period, Hastings emitted **gross** 1,869,526 tCO_2e. Note that gross emissions do not account for Forestry. Agriculture and Transport emissions are the largest contributors to total gross emissions for the district.

The population of Hastings in 2020/21 was approximately 89,600 people, resulting in per capita gross emissions of 20.9 tCO_2e/person. Discussion of per capita emissions is limited to when it is useful for comparing emission figures against other territorial authorities. A breakdown of net emissions (i.e. including results from Forestry resources) is reported separately.

Table 1 Total net and gross emissions

Total emissions	tCO_2e
Total Net Emissions (including forestry)	552,948
Total Gross emissions (excluding forestry)	1,869,526

Figure 3: Hastings District's total gross GHG emissions split by sector (tCO_2e).



During the 2020/21 reporting period, Hastings emitted **net** 552,948 tCO_2e.

Net emissions differ from gross emissions because they include emissions related to forestry activity (harvesting emissions and sequestration) within an area. Forestry emissions are influenced by the cyclical nature of harvesting and planting regimes.

Carbon sequestered by forestry can be viewed as a liability/risk that needs careful consideration. For example, if plantations are not replanted or other land use change occurs to exotic forested areas, then net emissions may rise quickly. Equally, if native forest is not protected from removal, and removal does happen, then net emissions may rise.

The community carbon footprint comprises emissions from six different sectors, summarised below:

3.1 Agriculture

The highest emitting sector in Hastings, Agriculture, emitted 1,158,601 tCO_2e in 2020/21 (Table 2). Agricultural emissions are the result of both livestock and crop farming. Enteric fermentation from livestock produced 77% of Hastings agricultural emissions (893,298 tCO_2e). Enteric fermentation GHG emissions are produced by methane (CH_4) released from the digestive process of ruminant animals (e.g. cattle and sheep). The second highest source of agricultural emissions was produced from nitrous oxide (N_2O) released by unmanaged manure from grazing animals on pasture (130,582 tCO_2e or 11% of the agricultural sector's emissions).

Table 2 Agriculture emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Enteric Fermentation	893,298	47.8%	77.1%
Manure from Grazing Animals	130,582	7.0%	11.3%
Other Agriculture Emissions	50,642	2.7%	4.4%
Atmospheric Deposition	36,365	1.9%	3.1%
Fertiliser used in Horticulture	22,615	1.2%	2.0%
Manure Management	17,625	0.9%	1.5%
Agricultural Soils	7,474	0.4%	0.6%
Total	**1,158,601**	**62%**	**100%**

Livestock were responsible for the majority of the Agriculture sector's GHG emissions (60%, or 1,121,627 tCO_2e) (Table 3). Sheep account for 48% of agricultural emissions and 30% of gross emissions in Hastings. Non-dairy cattle account for 38% of agricultural emissions and 24% of gross emissions in Hastings.

Table 3 Agriculture emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Sheep	559,552	30.0%	48.3%
Non-dairy Cattle	443,183	23.7%	38.3%
Dairy Cattle	94,725	5.1%	8.2%
Other livestock	24,169	1.3%	2.1%
Fertiliser for Horticulture	22,615	1.2%	2.0%
Fertiliser (other)	14,357	0.8%	1.2%
Total	**1,158,601**	**62%**	**100%**

Fertilisers used for livestock and horticulture represent 3% of Agriculture emissions. An additional breakdown of emissions from fertiliser use in horticulture is included based on land-use information provided by HBRC. Fertiliser use in horticulture represented 2% of the sector emissions. The largest contributor to 'Fertiliser for Horticulture' emissions in Hastings was sweetcorn (12,394 tCO_2e, 1.1% of Agricultural emissions) (Table 4). There is some potential for emissions double counting between the 'Fertiliser for Horticulture' and 'Fertiliser (other)' as these emissions have been calculated based on different datasets, where the 'Fertiliser (other)' category may also include some fertilisers used in horticulture. However, it is expected that the majority of the 'Fertiliser (other)' emissions are caused by

fertiliser use for livestock land. Changes in soil carbon associated with horticulture have not been quantified due to absence of a defined appropriate method for assessing the carbon footprint associated with soil carbon change over time.

Table 4 Fertiliser used in horticulture emissions by emission source

Sector / Emissions Source	tCO_2e	Hectares (Ha)
Sweetcorn	12,394	3,947
Pipfruit	2,333	4,734
Squash	2,145	1,702
Peas and Beans	1,450	2,736
Stonefruit	1,206	2,446
Beetroot	963	1,818
Grapes	892	5,245
Onions	822	473
Wheat	192	243
Kiwifruit	144	211
Grain	68	86
Tomato	6	80
Total	**22,615**	**23,721**

3.2 Transport

Transport produced 436,382 tCO_2e in 2020/21 (23% of Hastings gross total emissions). Table 5 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emission source.

Table 5 Transport emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Diesel	239,108	12.8%	54.8%
Petrol	155,638	8.3%	35.7%
Marine Freight	38,954	2.1%	8.9%
Jet Kerosene	1,307	0.1%	0.3%
LPG	767	<0.1%	0.2%
Rail	473	<0.1%	0.1%
Aviation Gas	134	<0.1%	<0.1%
Total	**436,382**	**23%**	**100%**

Most of the Transport emissions can be attributed to diesel and petrol, which produced 239,108 tCO_2e and 155,638 respectively (collectively 91% of the sector's emissions and 21% of total gross emissions). Diesel and petrol transport emissions are broken down into on-road and off-road use. On-road transport consists of all standard transportation vehicles used on roads (including cars, trucks, buses, etc.). Off-road transport consists of all fuel used for the movement of machinery and vehicles off roads (including agricultural tractors and vehicles, forklifts, etc.). On-road transport produced 348,332 tCO_2e (80% of Transport emissions) and Off-road transport produced 47,182 tCO_2e (11% of Transport emissions). An extra breakdown of on-road emissions by vehicle type and class is provided separate to this report.

The next largest Transport emission source for Hastings is marine freight, which contributed to 9% of the sectors emissions and 2% of total gross emissions (38,954 tCO_2e). Marine freight emissions are the result of freight movements to and from the Port of Napier. Emissions from this source have been divided between all territorial authorities in the Hawke's Bay region based on relative population sizes. It is understood that the imports and exports through this port are not exclusively related to activities in the Hawke's Bay region, however, to ensure that these emissions are reflected in community carbon footprints as per the GPC requirements this approach is appropriate.

The remaining transport emissions are attributed to air travel (jet kerosene and aviation gas), rail freight emissions, and LPG use for transport (e.g. forklifts).

3.3 Stationary Energy

Producing 210,474 tCO_2e in 2020/21, Stationary Energy was Hastings third highest emitting sector (11% of total gross emissions). Table 6 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emission source.

Table 6 Stationary Energy emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Electricity Consumption	89,761	4.8%	42.6%
Natural Gas	69,772	3.7%	33.2%
Stationary Petrol & Diesel Use	26,537	1.4%	12.6%
Electricity Transmission and Distribution Losses	8,245	0.4%	3.9%
LPG	6,083	0.3%	2.9%
Natural Gas Transmission and Distribution Losses	5,640	0.3%	2.7%
Biofuel / Wood	2,703	0.1%	1.3%
Coal	1,679	0.1%	0.8%
Biogas	54	<0.1%	<0.1%
Total:	**210,474**	**11%**	**100%**

Electricity consumption was the cause of 43% of Stationary Energy emissions (89,761 tCO_2e), and 4.8% of Hastings's total gross emissions (98,006 tCO_2e when including transmission and distribution losses related to the consumption). Natural gas consumption accounted for 36% of Stationary Energy emissions (75,412 tCO_2e) when including transmission and distribution losses. The industrial sector is the primary consumer of electricity and natural gas in Hastings.

Stationary petrol and diesel consumption generated 13% of the sectors emissions (26,537 tCO_2e). Use of LPG, and the burning of coal, biofuels and biogas produced the remaining Stationary Energy emissions.

Stationary Energy demand can also be broken down by fuel type, and by the sector in which it is consumed. Stationary Energy demand is reported for the following sectors: commercial; residential and industrial. However, emissions from petrol and diesel used for Stationary Energy are not able to be broken down by sector.

- Industrial Stationary Energy consumption accounts for 50% of Stationary Energy emissions (105,970 tCO_2e) and 6% of total gross emissions. Industrial Stationary Energy is energy used

within all industrial settings (including agriculture, forestry and fishing, mining, food processing, textiles, chemicals, metals, mechanical/electrical equipment and building and construction activities).

- Residential Stationary Energy consumption accounts for 20% of Stationary Energy emissions (41,443 tCO_2e) and 2% of total gross emissions. Residential Stationary Energy is energy used in homes (e.g. for heating, lighting, and cooking).
- Commercial Stationary Energy consumption accounts for 17% of Stationary Energy emissions (36,470 tCO_2e) and 2.0% of total gross emissions. Commercial Stationary Energy is energy used in all non-residential and non-industrial settings (e.g. in retail, hospitality, education, and healthcare).
- The remaining 13% of Stationary Energy emissions (26,591tCO_2e, 1% of gross emissions) were produced by diesel and petrol, and the burning of biogas, which were not allocated to the above categories. Stationary Energy uses of diesel and petrol include stationary generators and motors and for heating.

3.4 Waste

Waste originating in Hastings (solid waste and wastewater) produced 39,289 tCO_2e in 2020/21, which comprises 2% of Hastings total gross emissions. Table 7 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emission source.

Table 7 Waste emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Waste in open landfill sites	23,671	1.3%	60.2%
Composting	5,521	0.3%	14.1%
Waste in closed landfill sites	4,406	0.2%	11.2%
Individual septic tanks	4,233	0.2%	10.8%
Wastewater treatment plants	1,459	0.1%	3.7%
Total:	**39,289**	**2%**	**100%**

Solid waste produced the bulk of waste emissions (28,077 tCO_2e in 2020/21), making up 72% of total Waste emissions. Solid waste emissions include emissions from open landfills and closed landfills. Open landfill sites contributed 23,671 tCO_2e and emissions from closed landfill sites produced 4,406 tCO_2e in 2020/21. Both open and closed landfills emit landfill (methane) gas from the breakdown of organic materials disposed of in the landfill for many years after waste enters the landfill. However, annual emissions from closed landfill sites will decrease over time as no new waste enters these sites. Waste from Hastings is sent to Omarunui Landfill located within the Hastings geographic boundary.

Composting is the second largest source of emissions in Hastings, accounting for 14% of total waste emissions (5,521 tCO_2e in 2020/21). Waste diverted from landfill for composting in the Hawke's Bay Region includes horticultural, animal waste products, green waste, bark and sawdust.

Wastewater treatment (treatment plants and individual septic tanks) produced 5,691 tCO_2e making up 15% of total Waste emissions. More than half of households in Hastings are connected to wastewater treatments plants, which produced total emissions of 1,459 tCO_2e. Households connected to individual septic tanks produced 4,233 tCO_2e in wastewater emissions. Due to the production of methane, septic tanks have a higher emissions intensity compared to the wastewater treatments plants in Hastings.

Wastewater treatment tends to be a relatively small emission source compared to solid waste as advanced treatment of wastewater produces low emissions. In contrast, solid waste generates methane gas over many years as organic material enters landfill and emissions depend on the efficiency and scale of landfill gas capture.

3.5 Industrial Processes and Product Use (IPPU)

IPPU in Hastings produced 24,780 tCO_2e in 2020/21, contributing 1% to Hastings total gross emissions. This sector includes emissions associated with the consumption of GHGs for refrigerants, foam blowing, fire extinguishers, aerosols, metered dose inhalers and Sulphur Hexafluoride for electrical insulation and equipment production. IPPU emissions do not include energy use for industrial manufacturing, which is included in the relevant Stationary Energy sub-category (e.g. coal, electricity and/or petrol and diesel). These emissions are based on nationally reported IPPU emissions and apportioned based on population due to the difficulty of allocating emissions to particular geographic locations. Addressing IPPU emissions is typically a national policy issue.

There are no known industrial processes (as defined in the GPC requirements) present in Hastings (e.g. aluminium manufacture).

Table 8 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emission source. The most significant contributor to IPPU emissions is the use of refrigerants which produced 93% of IPPU emissions (23,039 tCO_2e).

Table 8 Industrial processes and product use emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Refrigerants and air conditioning	23,039	1.2%	93.0%
Aerosols	1,290	0.1%	5.2%
SF6 - Electrical Equipment	252	<0.1%	1.0%
Foam Blowing	109	<0.1%	0.4%
SF6 - Other	49	<0.1%	0.2%
Fire extinguishers	40	<0.1%	0.2%
Total	**24,780**	**1.3%**	**100%**

3.6 Forestry

Planting of native forest (e.g. mānuka and kānuka) and exotic forest (e.g. pine), sequesters (captures) carbon from the atmosphere while the trees are growing to maturity. Harvesting of forest emits emissions via the release of carbon from organic matters and soils following harvesting. When sequestration by forests exceeds emissions from harvesting in a particular year, the extra quantity of carbon sequestered by forest reduces total net emissions for that year. Conversely when emissions from harvesting exceed the amount of carbon sequestered by native and exotic forests, then total net emissions will increase.

Sequestration in 2020/21 was 2,710,299 tCO_2e (which was mostly from exotic forestry) while harvesting emissions were 1,393,722 tCO_2e. This meant that Forestry in Hastings was a net negative source of emissions in 2020/21 (rather than a positive source of emissions, where harvesting emissions exceeds sequestration). Total Forestry emissions in 2020/21 were -1,316,577 tCO_2e. It is noted that harvesting of exotic forest can be cyclical in nature where some years will have higher sequestration and some years will have higher harvesting emissions determined by age of forests, commercial operators, and the global market.

Table 9 Forestry emissions by emission source (including sequestration)

Sector / Emissions Source	tCO_2e
Total harvest emissions	1,393,722
Native forest sequestration	-466,431
Exotic forest sequestration	-2,243,868
Total	**-1,316,577**

3.7 Total Gross Emissions by Greenhouse Gas

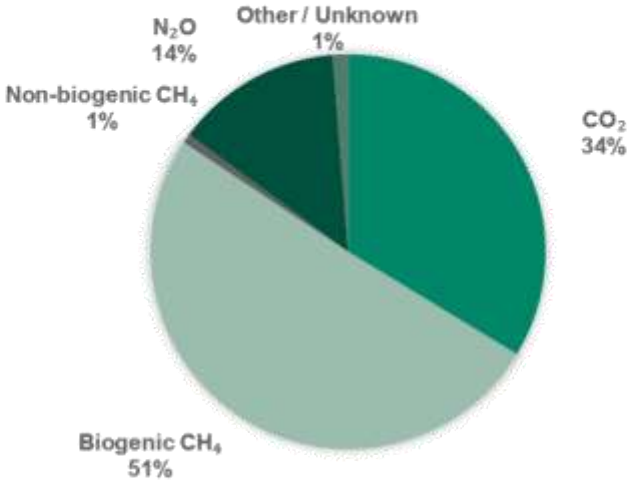
Each greenhouse gas has a different level of impact on climate change, this is accounted for when converting quantities of each gas into units of carbon dioxide equivalent (CO_2e).

Table 10: Hastings total gross emissions, by greenhouse gas

Greenhouse Gas	Tonnes	Tonnes of CO_2e
Carbon Dioxide (CO_2)	625,039	625,039
Biogenic Methane (CH_4)	27,947	950,199
Non-biogenic Methane (CH_4)	408	13,887
Nitrous Oxide (N_2O)	862	256,958
Other / Unknown Gas (in CO_2e)	23,443	23,443
Total	**677,700**	**1,869,526**

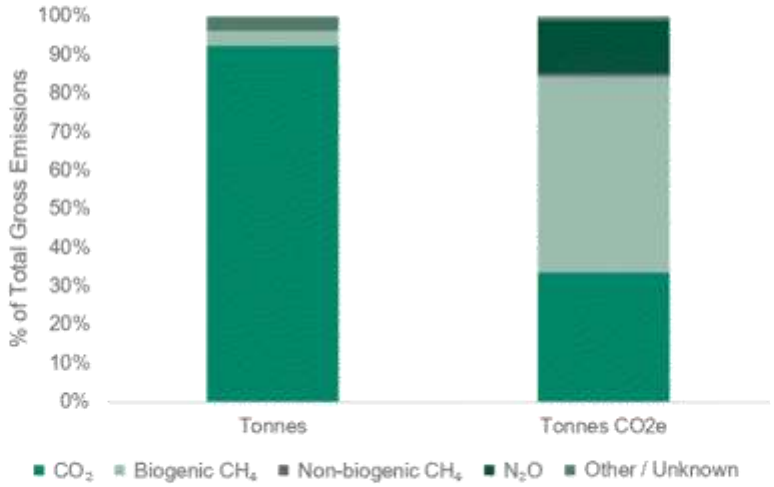
Figure 4 illustrates Hastings total gross emissions by greenhouse gas in units of carbon dioxide equivalents (CO_2e).

Figure 4: Hastings District's total gross emissions, by greenhouse gas (in tCO_2e)



By far the largest source of emissions in tonnes is carbon dioxide (CO_2) at 625,039 tonnes. Due to the greater global warming impact of methane, methane represents 4% of the total tonnage of GHG emissions from Hastings but represents 51% of CO_2e. Nitrous oxide represents 0.1% of the total tonnage of GHG emissions from Hastings but represents 14% of CO_2e. This effect can be seen in Figure 5.

Figure 5: Hastings District's total gross emissions, by greenhouse gas in tonnes and in tonnes of CO_2e



3.8 Biogenic emissions

Biogenic carbon dioxide and methane emissions are stated in Table 11 and Table 12, respectively.

Biogenic CO_2 emissions are those that result from the combustion of biomass materials that store and sequester CO_2, including materials used to make biofuels (e.g. trees, crops, vegetable oils, or animal fats). Biogenic CO_2 emissions from plants and animals are excluded from gross and net emissions as they are part of the natural carbon cycle.

Table 11: Biogenic CO_2 in Hastings (Excluded from gross emissions)

Biogenic Carbon Dioxide (CO_2) (Excluded from gross emissions)		
Biofuel	88,504	t CO_2
Landfill Gas	8,334	t CO_2
Total Biogenic CO_2	**96,838**	**t CO_2**

Biogenic CH_4 emissions (e.g., produced by farmed cattle via enteric fermentation) are included in gross emissions due to their relatively large impact on global warming relative to biogenic CO_2. Biogenic methane represents 4% of the gross total tonnage of GHG emissions in Hastings but represents 51% of total gross GHG emissions when expressed in CO_2e. This is caused by the higher global warming impact of methane per tonne, compared to carbon dioxide. The total tonnage of each GHG and the contribution of each GHG to total gross emissions when expressed in CO_2e is shown in Table 10.

The importance of biogenic CH_4 is highlighted in NZ's Climate Change Response (Zero Carbon) Amendment Act. The Act includes specific targets to reduce biogenic CH_4 by between 24% and 47% below 2017 levels by 2050, and by 10% below 2017 levels by 2030. More information on the Act is available here: https://www.mfe.govt.nz/climate-change/zero-carbon-amendment-act.

Table 12: Biogenic Methane in Hastings (Included in gross emissions)

Biogenic Methane (CH_4) (Included in gross emissions)		
Enteric Fermentation	26,273	t CH4
Landfill Gas	826	t CH4
Manure Management	518	t CH4
Wastewater Treatment	164	t CH4
Composting	94	t CH4
Biofuel	71	t CH4
Total Biogenic CH_4	27,947	**t CH4**

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3.9 Territorial Authorities in the Hawke's Bay Region

The Hawke's Bay regional area contains several territorial authorities. Hastings District, Napier City, Central Hawkes Bay District, and Wairoa District are all exclusively within the boundaries of the Hawke's Bay region. Additionally, areas of Taupō District and Rangitīkei District are also part of the Hawke's Bay region. We estimate that 0.1% of Taupō's population and 12% of Taupō's area, and 0.3% of Rangitīkei's population and 14% of Rangitīkei's area are within the Hawke's Bay region.

Figure 6 shows the Hawke's Bay's total gross emissions divided by territorial authority. Figure 7 shows total gross emissions for the territorial authorities in the Hawke's Bay Region, split by sector. Both figures only include the emissions produced within the Hawke's Bay region for Taupō and Rangitīkei.

Hastings is the highest emitting territorial authority in the region, representing 43% of the Hawke's Bay's total gross emissions. Hastings' emissions inventory is predominantly agriculture-related emissions with the next largest emitting territorial authorities; Central Hawke's Bay and Wairoa, also containing significant agricultural emissions. Of the four territorial authorities entirely within the Hawke's Bay region, Napier has the lowest total gross emissions, with emissions mostly from Transport and Stationary Energy. The areas of Taupō and Rangitīkei contribute to 2% of the Hawke's Bay region's total gross emissions, almost entirely from Agriculture.

Figure 6 Hawke's Bay's total gross emissions divided by territorial authority (tCO_2e). *Taupō and Rangitīkei totals only include emissions produced in the Hawke's Bay region.

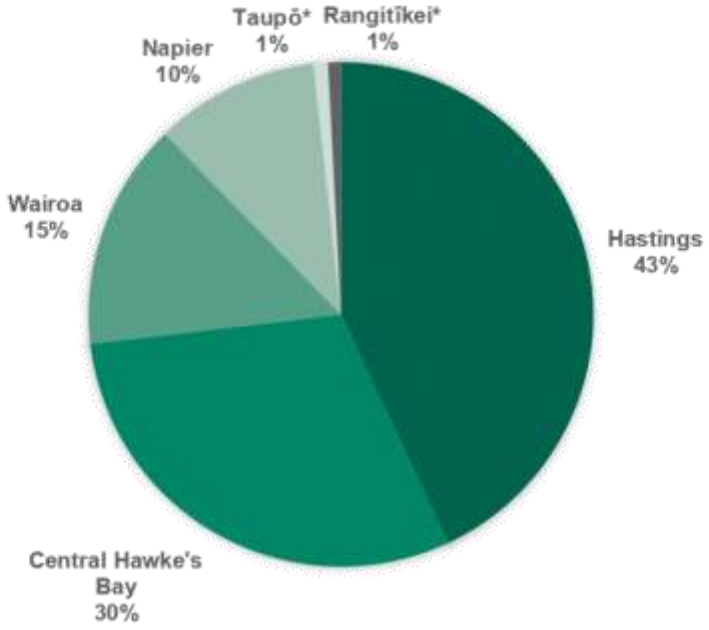
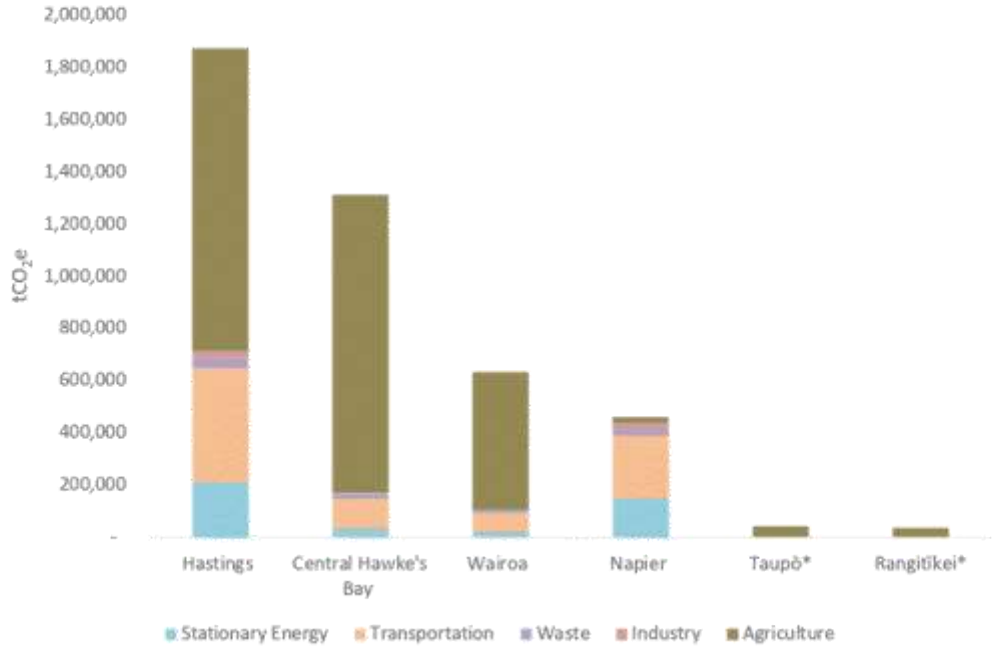


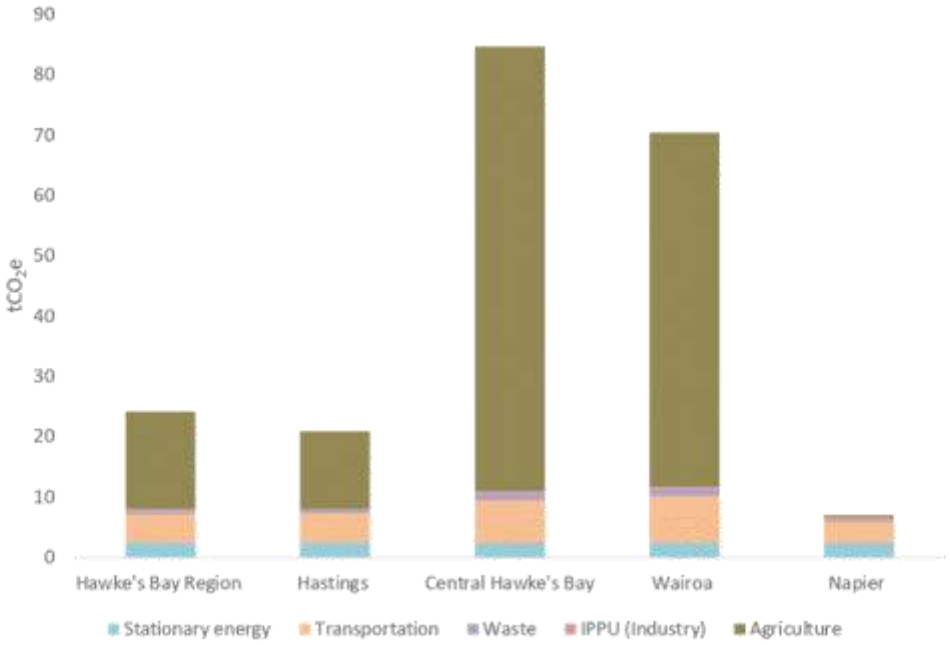
Figure 7 Total gross emissions by territorial authority in the Hawke's Bay region (tCO_2e). *Taupō and Rangitīkei totals only include emissions produced in the Hawke's Bay region.



When comparing emissions inventories from different areas, a per capita figure can be useful because it provides a common reference point to understand the difference in emissions. Figure 8 shows emissions per capita for the region and territorial authorities within the region. Taupō and Rangitīkei are excluded from this figure due to the tiny population and large agriculture within the small area in the Hawke's Bay creating very large per capita emissions (this is not the case for the entire Taupō or Rangitīkei district).

The Hawke's Bay region has a 24.1 tCO_2e/per capita figure for total gross emissions which is higher than the national value of 15.7 tCO_2e/per capita. Napier has the lowest per capita total emissions at 6.9 tCO_2e/per capita. Central Hawke's Bay and Wairoa have the largest per capita total gross emissions at 84.6 tCO_2e/per capita and 70.3 tCO_2e/per capita respectively, both due to high Agriculture emissions in the district. Hastings has the third highest per capita emissions at 20.9 tCO_2e/per capita, similar to that of the region. Notably, Hastings' per capita transport emissions are lower than Central Hawke's Bay and Wairoa, but higher than Napier.

Figure 8 Total gross emissions per capita for the region and territorial authorities within the region (tCO_2e). *Taupō and Rangitīkei areas not included



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4.0 Emissions change from 2018/19 to 2020/21

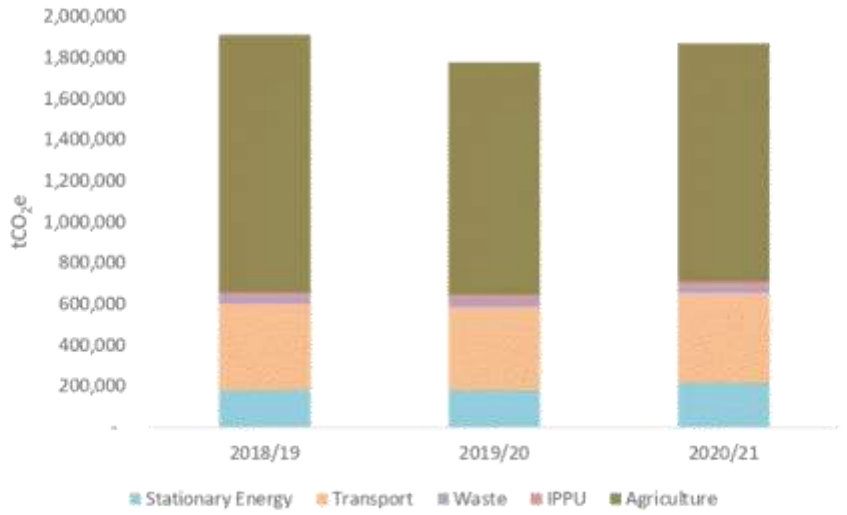
Alongside calculating Hastings' emissions footprint for 2020/21, we have calculated Hastings' emissions footprint for 2018/19 and 2019/20. This section displays the results of the 2018/19, 2019/20, and 2020/21 emissions footprints with a focus on Gross emissions and documents the change in emissions from 2018/19 to 2020/21.

An analysis of the impact of the COVID-19 pandemic on Hastings' emissions is found in Section 6.0. This section is cautious in examining the interpretation of changes, due to the footprint only assessing one financial year (2018/19) prior to the COVID-19 pandemic disruptions.

Table 13 Change in Hastings total gross and net emissions from 2018/19 to 2020/21

	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Total Net Emissions (including forestry)	1,113,118	603,120	552,948	-50%
Total Gross Emissions (excluding forestry)	1,911,938	1,776,377	1,869,526	-2%

Figure 9 Change in Hastings total gross emissions from 2018/19 to 2020/21



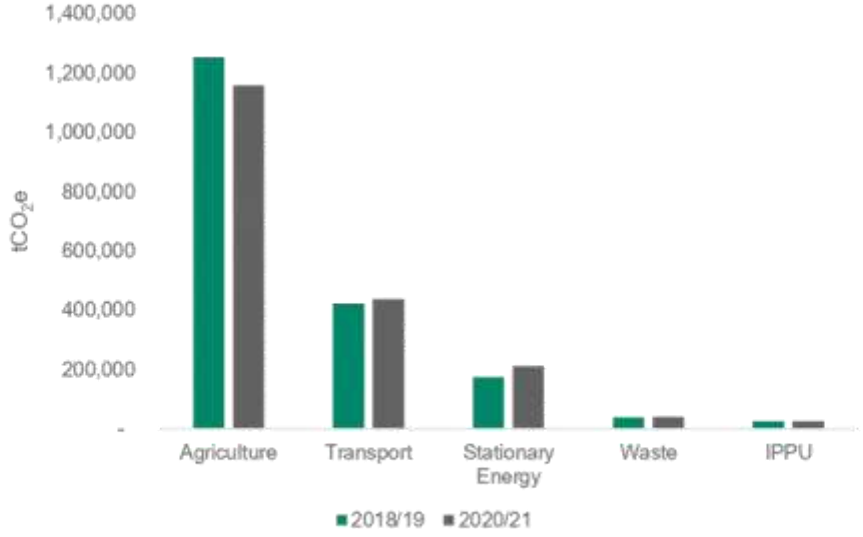
Annual total gross emissions decreased by 2% from 1,911,938 tCO_2e in 2018/19 to 1,869,526 tCO_2e in 2020/21. This was driven by a decrease in Agriculture emissions (due to a decrease in the number of sheep and non-dairy cattle) and an increase in Stationary Energy emissions (primarily related to the increase in the emissions intensity of the national electricity grid).

Total net emissions in Hastings decreased by 50% from 1,113,118 in 2018/19 to 552,948 tCO_2e. This decrease was predominantly due to a decrease in annual forest harvesting emissions. This is discussed further below under the 'Forestry' heading.

Whilst total gross emissions decreased by 2%, the population of Hastings grew by 5% during this time. This resulted in a 7% decrease in per capita emissions between 2018/19 and 2020/21, from 22.4 to 20.9 tCO_2e per person per year. A discussion of the decoupling of gross emissions from population growth and GDP is found in Section 5.0.

The sections below outline the change in emissions between 2018/19 and 2020/21 for each sector and emissions source, highlighting the changes that have had the largest impact on total gross emissions.

Figure 10 Emissions for each sector of Hastings gross emissions footprint for 2018/19 and 2020/21



4.1 Agriculture

Table 14 Change in Hastings Agriculture emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Enteric Fermentation	964,879	870,217	893,298	-7%
Manure from Grazing Animals	141,496	127,196	130,582	-8%
Other Agriculture Emissions	56,335	50,376	50,642	-10%
Atmospheric Deposition	39,639	35,603	36,365	-8%
Fertiliser used in Horticulture	22,615	22,615	22,615	0%
Manure Management	19,098	17,578	17,625	-8%
Agricultural Soils	9,796	8,496	7,474	-24%
Total	**1,253,858**	**1,132,080**	**1,158,601**	**-8%**

Agriculture is the most significant contributor to Hastings community carbon footprint. The sector's emissions decreased by 8% between 2018/19 and 2020/21 (95,257 tCO_2e). This decrease is driven by a reduction in total livestock numbers, especially of sheep and non-dairy cattle (see Table 15).

Emissions related to sheep decreased by 58,476 tCO_2e due to a reduction in the number of sheep (106,683 sheep). Emissions related to non-dairy cattle decreased by 24,980 tCO_2e due to a reduction in the number of non-dairy cattle (12,596 cattle). The number of dairy cattle also reduced, reducing dairy cattle emissions by 6,586 tCO_2e.

Table 15 Change in Hastings livestock numbers from 2018/19 to 2020/21

	Number of animals (2018/19)	Number of animals (2020/21)	Change in number of animals (2018/19 to 2020/21)
Sheep	1,127,513	1,020,830	-106,683
Non-dairy Cattle	185,391	172,796	-12,596
Other livestock	26,639	26,472	-167
Dairy Cattle	25,191	23,320	-1,871
Total livestock	**1,364,734**	**1,243,418**	**-121,316**

Table 16 Change in Hastings's livestock-associated Agriculture emissions from 2018/19 to 2020/21

	2018/19 emissions (tCO_2e)	2020/21 emissions (tCO_2e)	% Change in emissions (2018/19 to 2020/21)
Sheep	618,028	559,552	-9%
Non-dairy Cattle	468,073	443,183	-5%
Dairy Cattle	101,311	94,725	-7%
Other livestock	24,872	24,169	-3%
Total livestock	**1,212,284**	**1,121,628**	**-7%**

4.2 Transport

Table 17 Change in Hastings's Transport emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Diesel	218,190	213,706	239,108	10%
Petrol	155,779	145,783	155,638	<0.1%
Marine Freight	44,603	44,777	38,954	-13%
Jet Kerosene	1,878	1,626	1,307	-30%
LPG	718	730	767	7%
Rail	468	717	473	1%
Aviation Gas	108	130	134	25%
Total:	**421,744**	**407,469**	**436,382**	**3%**

Transport emissions increased by 3% between 2018/19 and 2020/21 (14,639 tCO_2e). This was driven by a 5% increase in on-road fuel emissions (16,826 tCO_2e), particularly from diesel.

It is noted that the impact of the COVID-19 pandemic can be seen in Transport emissions where emissions decreased by 4% between 2018/19 and 2019/20 due to reductions in road and air transport fuel use. Aviation emissions continued to reduce in the 2020/21 reporting year, reflective of ongoing COVID-19 impacts to the industry.

4.3 Stationary Energy

Table 18 Change in Hastings Stationary Energy emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Natural Gas	66,437	64,443	69,772	5%
Electricity Consumption	61,265	63,108	89,761	47%
Stationary Petrol & Diesel Use	24,315	23,766	26,537	9%
LPG	5,688	5,784	6,083	7%
Natural Gas Transmission and Distribution Losses	5,370	5,209	5,640	5%
Electricity Transmission and Distribution Losses	5,349	5,532	8,245	54%
Coal	2,857	3,142	1,679	-41%
Biofuel / Wood	2,661	2,679	2,703	2%
Biogas (landfill)	52	53	54	4%
Total:	**173,995**	**173,715**	**210,474**	**21%**

Emissions from Stationary Energy increased by 21% between 2018/19 and 2020/21 (36,479 tCO_2e). This was driven by a 47% increase in electricity consumption emissions (28,495 tCO_2e). This increase in electricity consumption emissions was due to a 4% increase in energy consumption (kWh) and a 41% increase in the emissions intensity of the national electricity grid (tCO_2e/kWh). The emissions intensity of the national grid has increased in recent years due to the increased use of fossil fuels during years with low hydro electricity generation. Emissions from industrial energy use is the largest driver in the increase in stationary emissions (15,236 tCO_2e).

4.4 Waste

Table 19 Change in Hastings Waste emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Open Landfill	22,695	23,087	23,671	4%
Composting	5,521	5,521	5,521	-
Closed Landfill	4,891	4,641	4,406	-10%
Individual septic tanks	3,293	3,780	4,233	29%
Wastewater treatment plants	1,465	1,476	1,459	-0.4%
Total	**37,865**	**38,504**	**39,289**	**4%**

Waste emissions increased between 2018/19 and 2020/21, by 4% (1,425 tCO_2e).

Total solid waste in landfill emissions increased by 2% (491 tCO_2e). Emissions from waste in open landfills increased as the volume of waste entering the landfill increased and waste recently deposited in landfill reaches peak emissions per year (this is after approximately two years in landfill). Emissions from closed landfills decreased due to no extra waste being added, the existing waste in landfill releases fewer emissions over time. Due to data only being available for one singular year, no change in composting emissions is recorded.

Total wastewater emissions increased by 20%, this is due to an increase in septic tank emissions likely driven by an increase in the number of households not connected to centralized wastewater treatment. Due to the production of methane, septic tanks have a higher emissions intensity compared to a wastewater treatment plant. Better data on the number of households connected to centralized wastewater treatment would improve the accuracy of the emissions calculations.

4.5 Industrial Processes and Product Use (IPPU)

Table 20 Change in Hastings IPPU emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Refrigerants and air conditioning	22,639	22,833	23,039	2%
Aerosols	1,425	1,336	1,290	-9%
SF6 - Electrical Equipment	225	244	252	12%
Foam Blowing	99	108	109	10%
SF6 - Other	48.7	49.0	49.5	2%
Fire extinguishers	39	40	40	1%
Total	**24,476**	**24,609**	**24,780**	**1%**

IPPU emissions increased between 2018/19 and 2020/21, by 1% (304 tCO_2e). The increase in IPPU emissions is mainly caused by an increased in SF6 associated with electrical equipment. Note that national level data is used for this sector and is portioned out using a population approach; exact emissions for the district are unknown.

4.6 Forestry

Table 21 Change in Hastings Forestry emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Total harvest emissions	1,867,841	1,502,952	1,393,722	-25%
Native forest sequestration	-466,431	-466,431	-466,431	0%
Exotic forest sequestration	-2,200,230	-2,209,778	-2,243,868	2%
Total	**-798,819**	**-1,173,257**	**-1,316,577**	**65%**

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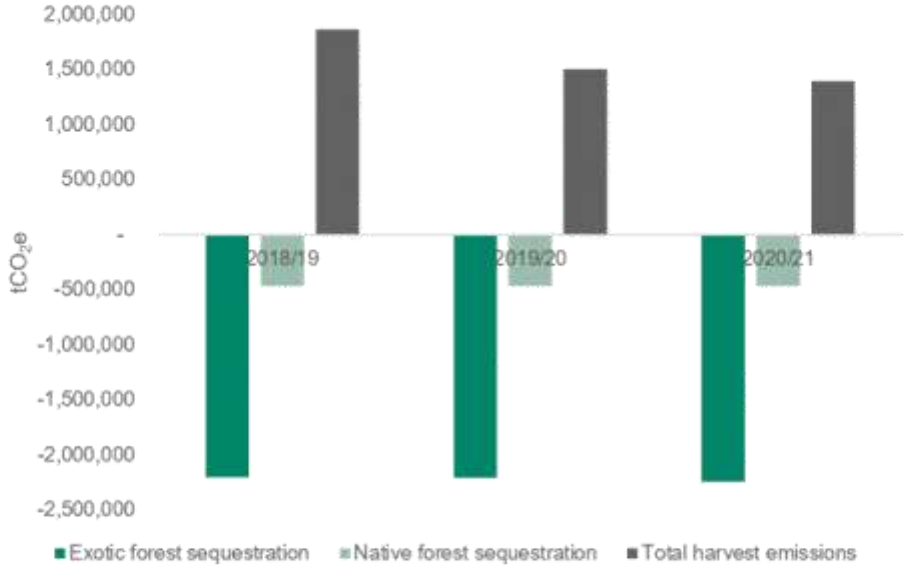
Forestry emissions decreased by 517,758 tCO_2e (65%) between 2018/19 and 2020/21, this is the largest real and proportional change in emissions for Hastings. This decreased was driven by a decrease in total harvest emissions (474,120 tCO_2e) as less exotic forest is harvested. Forestry emissions are influenced by the cyclical nature of harvesting and planting regimes where some years will have higher sequestration and some years will have higher harvesting emissions. This is dependent on age of forests and the demand for lumber and timber. This decrease in Hastings harvesting emissions during this period is reflective a decrease in forestry harvesting across the region. Improved and updated data sources may impact the estimation of emissions from this source in the future. Sequestration by native and exotic forest remained relatively stable during this time.

Figure 11 Forestry sequestration and harvesting emissions from 2018/19 to 2020/21



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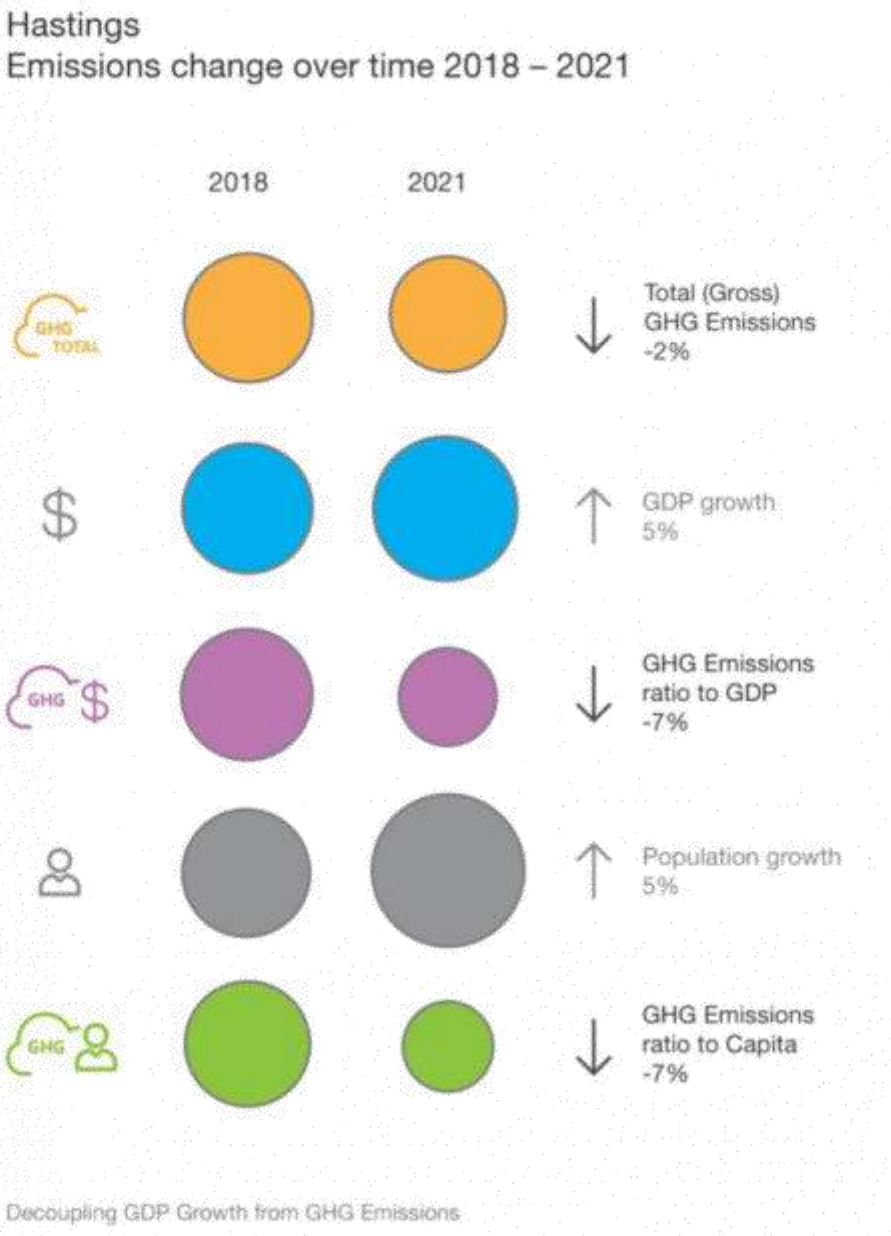
5.0 Decoupling of GHG emissions from population growth and GDP

Figure 12 shows the changes in gross emissions when compared to changes in other metrics of interest between 2018/19 and 2020/21. For example, total gross emissions have decreased by 2%, whilst population in Hastings has increased by 5%, resulting in a 7% reduction in total gross emissions per capita. Similarly, Gross Domestic Product (GDP) in Hastings has increased by 5%, resulting in a 7% decrease in the GHG emissions ratio to GDP.

When emissions grow less rapidly than GDP (a measure of income) this process is known as decoupling. The term decoupling is an expression of the desire to mitigate emissions without harming economic wellbeing. A full discussion of decoupling of emissions is beyond the scope of this project. However, the changes in emissions and GDP illustrated in Figure 12 and discussed above, suggest at a high-level decoupling has occurred between 2018/19 and 2020/21.

The exact drivers for the decoupling of emissions from GDP are difficult to pinpoint. New policies, for restructuring the way to meet demand for energy, food, transportation and housing will all contribute. In this case, both direct local actions (e.g. landfill gas reductions) and indirect national trends (e.g. changes to emissions from electricity generation) will have contributed to trends noted.

Figure 12 Change in total gross emissions compared to other metrics of interest



6.0 Impact of the COVID-19 pandemic on GHG Emissions

COVID-19 impacted New Zealand and the entire world during 2020 and 2021; causing widespread government-imposed restrictions on businesses and individuals and huge shifts in behaviors and economic markets. Restrictions in New Zealand relating to COVID-19 began in mid-March 2020 with many personal and business restrictions continuing past the end of 2019/20 and throughout 2020/21.[3]

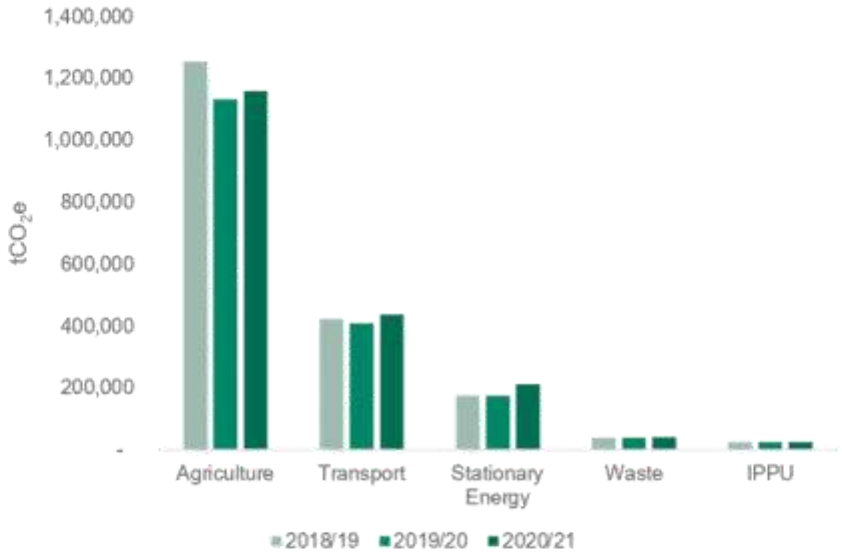
Globally, carbon dioxide emissions from fossil fuels (the largest contributor to greenhouse gas emissions) in 2020 decreased by 7% compared to 2019[4]. Emissions from the transportation sector account for the largest share of this decrease. Surface transport, e.g. car journeys, fell by approximately half at the peak of COVID-19 restrictions in April 2020 (when restrictions were at their maximum, particularly across Europe and the U.S. Globally, emissions recovered to near 2019 levels and are expected to continue to increase.

In New Zealand, national daily carbon dioxide emissions are estimated to have fallen by up to 41% during the level 4 lockdown in April 2020[5]. National gross emissions decreased by 3% from 2018/19 to 2019/20, which was largely driven by a decrease in fuel use in road transport due to COVID-19 pandemic restrictions, a decrease in fuel use in manufacturing industries and construction due to COVID-19 restrictions, and a decrease in fuel use from domestic aviation also due to COVID-19 restrictions.

Total gross emissions in Hastings decreased by 135,560 tCO_2e (7%) between 2018/19 and 2019/20. Total gross emissions then increased by 93,149 tCO_2e (5%) from 2019/20 to 2020/21.

The impact on emissions in different sectors varied. Notably, Transport emissions reduced by 4% between 2018/19 and 2019/20, driven by reduced road and air transport fuel use. Agricultural emissions decreased between 2018/19 and 2019/20, possibly due to COVID-related impacts on global supply chains. Despite changes in Stationary Energy, Waste, and IPPU emissions, these sectors are not judged to have been significantly affected by the COVID-19.

Figure 13 Hastings emissions per sector for 2018/19, 2019/20, and 2020/21 (tCO_2e)



[3] https://covid19.govt.nz/alert-system/history-of-the-covid-19-alert-system/
[4] Pierre Friedlingstein et al. - Global Carbon Budget 2020 (2020)
[5] Corinne Le Quere et al. – Temporary Reduction in Daily Global CO_2 Emissions During the COVID-19 Forced Confinement

7.0 Closing Statement

Hastings GHG emissions footprint provides information for decision-making and action by the council, Hastings stakeholders, and the wider community. We encourage the council to use the results of this study to update current climate actions plans and set emission reduction targets.

The emissions footprint developed for Hastings covers emissions produced in the Stationary Energy, Transport, Waste, IPPU, Agriculture, and Forestry sectors using the GPC reporting framework. Sector-level data allows Hastings to target and work with the sectors that contribute the most emissions to the footprint.

Understanding of the extensive and long-lasting effects of climate change is improving all the time. It is recommended that this emissions footprint be updated regularly (every two or three years) to inform ongoing positive decision making to address climate change issues.

The accuracy of any emissions footprint is limited by the availability, quality, and applicability of data. Areas where data could be improved for future footprints include forestry (forest cover and harvesting), agriculture (especially livestock numbers), wastewater, and on and off-road transport fuel use.

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8.0 Limitations

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Appendix A

Assumptions and Data Sources

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Sector / Category	Assumption and Exclusions
General	
Geographical Boundary	LGNZ local council mapping boundaries have been applied. The emissions footprint for the Hawke's Bay Region covers the entirety of the Hawke's Bay Region (this excludes some of the Rangitikei and Taupō territorial authorities). Emissions footprints for each territorial authority covers the entirety of the territorial authority area.
Population	Population figures are provided by StatsNZ. Financial year populations have been used, these are based on the average population from the two calendar years (e.g. the average of 2018 and 2019 calendar year populations for FY19). The population of Taupo and Rangitikei Districts within the Hawke's Bay geographical boundary has been calculated.
Transport Emissions	
Petrol and Diesel:	Petrol and diesel sales data provided by Napier City Council for Napier, Central Hawkes Bay and Hastings. Combined sales data for Gisborne and Wairoa provided by Gisborne District Council and allocated to a region based on Waka Kotahi emissions data. Sales have been divided between territorial authorities based on the number of kilometres travelled by vehicles on roads (VKT) in each territorial authority. VKT data provided by Waka Kotahi. The division into transport and stationary energy end use (and within transport into on-road and off-road) has been calculated using fuel end use data provided by the Energy Efficiency and Conservation Authority (EECA) from the 2019 database. Biofuel sales information provided directly by the supplier.
Rail Diesel	Emissions from fuel use have been calculated and provided by Kiwi Rail. The following assumptions were made: - Net Weight is product weight only and excludes container tare (the weight of an empty container) - The Net Tonne-Kilometres (NTK) measurement has been used. NTK is the sum of the tonnes carried multiplied by the distance travelled. - National fuel consumption rates have been used to derive litres of fuel for distance. - Type of locomotive engine used, and jurisdiction topography, have not been incorporated in the calculations. The trans-boundary routes were determined, and the number of stops taken along the way derived. The total amount of litres of diesel consumed per route was then split between the departure district, arrival district and any district the freight stopped at along the way. If the freight travelled through but did not stop within a district, no emissions were allocated. This data is subject to commercial confidentiality.
Jet Kerosene (Scheduled Flights) Aviation Gas (General Aviation)	Calculated from information provided by Hawke's Bay Airport. Aviation fuel and jet kerosene fuel volumes were provided and emissions have been calculated using these volumes. Emissions have been divided between territorial authorities based the relative population of each territorial authority.

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Marine Freight	Shipping schedules have been provided by the Port of Napier. Emissions have been calculated based on ship weight and distance from the origin/destination to Napier. This figure does not include fishing vessels, or vessels with destination to be confirmed. Emissions from freight and international shipping are allocated equally between the origin and destination area emissions footprints. It is expected that imports and exports travelling through the Port of Napier service the entire Hawke's Bay Region. Emissions relating to freight and international shipping emissions have been divided between all Hawke's Bay territorial authorities based on population size.
Marine Fuel (Local)	Non-freight marine fuel use has not been included in this study. Fuel use by Port of Napier-controlled vessels has not been included due to a lack of available information. Most private marine vessels use fuel purchased at vehicle fuel stations. Petrol and diesel used in private marine vessels is included in off-road transportation.
LPG Consumption	North Island LPG sales data (tonnes) has been provided by the LPG Association. 'Auto' and 'Forklift' sales represent transport uses of LPG. Sales have been divided between territorial authorities on a per capita basis.
Stationary Energy Emissions	
Electricity Demand	Electricity demand has been calculated using grid exit point (GXP) data from the EMI website (www.emi.ea.govt.nz). Reconciled demand has been used as per EMI's confirmation. The territorial authorities serviced by each GXP have been confirmed by the respective electricity suppliers. The breakdown into sectors (Residential, Commercial, and Industrial) is based on NZ average consumption per sector as per Ministry for the Environment (MfE) data.
Electricity Generation	Electricity generation has been calculated using data from the EMI website (www.emi.ea.govt.nz). Small electricity generation has not been included in this data (e.g. domestic solar generation). This figure only includes electricity that is connected to the national electricity grid, direct users of electricity are not included.
Coal Consumption	National coal consumption data has been provided by MBIE. Regional industrial coal data has been provided by EECA. National residential and commercial coal consumption has been divided between territorial authorities on a per capita basis. Regional industrial coal consumption has been divided between territorial authorities on a per capita basis.
Coal Production and Fugitive Emissions	Not Calculated: There are no active coal mines within the region.
Biofuel Consumption	National biofuel consumption data has been provided by the Ministry for Business, Innovation and Employment (MBIE). Biofuel consumption has been divided between territorial authorities on a per capita basis. Biofuel emissions are broken down into Biogenic emissions (CO_2) and Non-Biogenic emissions (CH_4 and N_2O)

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LPG Consumption	North Island LPG sales data (tonnes) has been provided by the LPG Association. 'Auto' and 'Forklift' sales represent transport uses of LPG. All other sales represent stationary energy uses of LPG. Sales have been divided between territorial authorities on a per capita basis. The breakdown into sectors (Residential, Commercial, and Industrial) is based on NZ average consumption per sector as per MfE data.
Natural Gas Consumption	Natural gas consumption data has been provided by FirstGas. Territorial Authorities supplied by gas from each Point of Connection (POC) have been confirmed by FirstGas. Natural gas consumption has been split into residential, commercial, and industrial consumption based on information provided by PowerCo and national statistics from MBIE. Some POCs supply gas to particular industrial users exclusively, these have been taken into account.
Oil and Gas Fugitive Emissions	Not Calculated: There are no gas or oil processing plants within the region.
Agricultural Emissions	
General	Territorial authority livestock numbers and fertiliser data taken from the Agricultural Census (StatsNZ). The last territorial authority census was in 2017. Regional agricultural data from StatsNZ (2021) has been used to estimate the change in livestock and fertiliser use since 2017. Territorial authority land-use data provided by HBRC covering horticulture land-use.
Solid Waste Emissions	
Waste in Landfill	Landfill waste volume and end location information has been provided by the respective council departments. Where information is not available, waste volumes have been estimated based on historical national data on a per capita basis. Emissions are allocated to territorial authorities based on where the waste was produced, even if the waste is disposed in landfill outside the territorial authority.
Wastewater Emissions	
Wastewater Volume and Treatment Systems	Information on treated wastewater, and treatment plants has been provided by the respective council departments. Where information is not available, reasonable assumptions have been made and the WaterNZ database has been consulted. The population connected to septic tank systems have been estimated by the respective council departments. Where the population covered by Wastewater treatment plants and septic tanks does not account for the entire population, the remaining population is assigned to septic tanks. Emissions are allocated to territorial authorities based on where the wastewater was produced, even if the wastewater is treated outside the territorial authority.
Industrial Emissions	
Industrial processes	It is assumed that there are no significant non-energy related emissions of greenhouse gasses from industrial processes in the Region (e.g. aluminium manufacture).
Industrial Product Use	National data covering industrial product use (e.g. fire extinguishers, refrigerants) has been provided by the MfE. Emissions have been allocated to territorial authorities on a per capita basis.

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Forestry Emissions	
Exotic Forestry Harvested	Harvested forestry, and forest cover information for each territorial authority has been derived from Landcare Research data. It has been assumed that only 70% of the tree is removed as roundwood and that the above ground tree makes up approximately 74% of the total carbon stored.
Exotic Forest	Exotic forest land area for each territorial authority has been provided by Landcare Research.
Emission Factors	
General	All emission factors have detailed source information in the calculation tables within which they are used. Where possible, the most up to date, NZ-specific EFs have been applied. AR5 Global Warming Potential (GWP) figures for greenhouse gases have been used accounting for climate change feedbacks.

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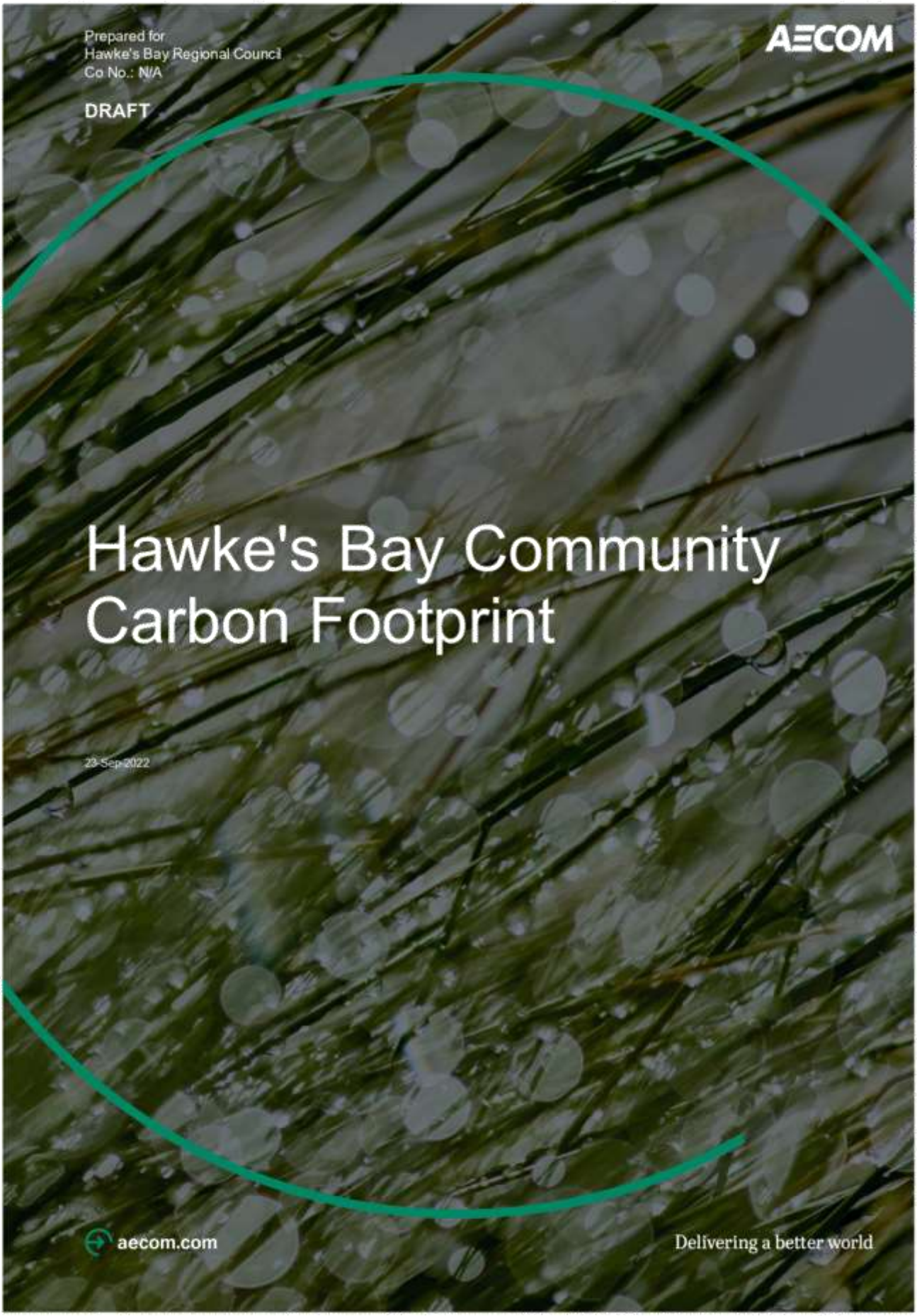
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Hawke's Bay Community Carbon Footprint

Client: Hawke's Bay Regional Council

Co No.: N/A

Prepared by

AECOM New Zealand Limited
Level 19, 171 Featherston Street, Wellington 6011, PO Box 27277, Wellington 6141, New Zealand
T +64 4 896 6000 F +64 4 896 6001 www.aecom.com

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Quality Information

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Reviewed by Anthony Hume

Revision History

Rev	Revision Date	Details	Authorised	
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1	23-Sept-2022	Final draft	Anthony Hume Team Leader - Sustainability	

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Executive Summary

Greenhouse Gas (GHG) emissions for the Hawke's Bay Region (that is covered by the Hawke's Bay Regional Council) have been measured using the Global Protocol for Community Scale Greenhouse Gas Emissions Inventory (GPC) methodology. This approach includes emissions from Stationary Energy, Transport, Waste, Industrial Processes and Product Use (IPPU), Agriculture and Forestry sectors. This document reports greenhouse gas emissions produced in or resulting from activity or consumption within the geographic boundaries of the Hawke's Bay Region for the 2020/21 financial reporting year and examines greenhouse gas emissions produced from 2015/16 to 2020/21.

The Hawke's Bay Region is referred to hereafter as Hawke's Bay for ease. Greenhouse gas emissions are generally reported in this document in units of Carbon Dioxide Equivalents (CO_2e) and are referred to as 'emissions'.

Major findings of the project include:

2020/21 Emissions Footprint

- In the 2020/21 reporting year (1st July 2020 to 30th June 2021), **total gross emissions** in Hawke's Bay were 4,345,997 tCO_2e.
- **Agriculture** (e.g., emissions from livestock and crops) is the largest source of emissions, accounting for 67% of the Hawke's Bay's total gross emissions, with enteric fermentation from livestock accounting for 78% of Agriculture emissions.
- **Transport** (e.g., emissions from road and air travel) is the second largest emitting sector in Hawke's Bay, representing 20% of total gross emissions, with petrol and diesel consumption accounting for 90% of Transport emissions.
- **Stationary Energy** (e.g., consumption of electricity and natural gas) is the third highest emitting sector in the region, producing 10% of total gross emissions.
- Net **Forestry** emissions were -2,862,841 in 2020/21 as carbon sequestration (carbon captured and stored in plants or soil by forests) was higher than emissions from forest harvesting (e.g., the release of carbon from roots and organic matter following harvesting).
- The **total net emissions** in Hawke's Bay were 1,483,156 tCO_2e. Total net emissions include emissions and sequestration from Forestry.

Changes in Emissions, 2018/19 to 2020/21

- Between 2018/19 and 2020/21, **total gross emissions** in Hawke's Bay decreased from 4,497,263 tCO_2e to 4,345,997 tCO_2e, a decrease of 3% (151,267 tCO_2e).
- Over this time the population of the Region increased by 4%, resulting in **per capita gross emissions** in Hawke's Bay decreasing by 7% between 2018/19 and 2020/21, from 25.9 to 24.1 tCO_2e per person per year.
- Emissions from **Stationary Energy** increased by 20% between 2018/19 and 2020/21 (69,806 tCO_2e), driven by a 45% increase in electricity consumption emissions (56,198 tCO_2e). This increase in electricity consumption emissions was due to a 4% increase in electricity consumption (kWh) coupled with a 41% increase in the emissions intensity of the national electricity grid (tCO_2e/kWh).
- Emissions from **Agriculture** decreased by 8%, between 2018/19 and 2020/21 (245,553 tCO_2e), due to a reduction in livestock numbers, particularly of sheep and non-dairy cattle.
- **Transport** and **Waste** emissions both increased by 3% (21,822 tCO_2e and 2,491 tCO_2e respectively).
- Emissions from forest harvesting reduced by 3% (118,442 tCO_2e), while sequestration from forestry increased by 2% (102,706 tCO_2e) resulting in the net impact of **Forestry** changing by 8% from -2,641,693 tCO_2e to -2,862,841tCO_2e.

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Figure 1: Hawke's Bay 2020/21 Emissions Footprint

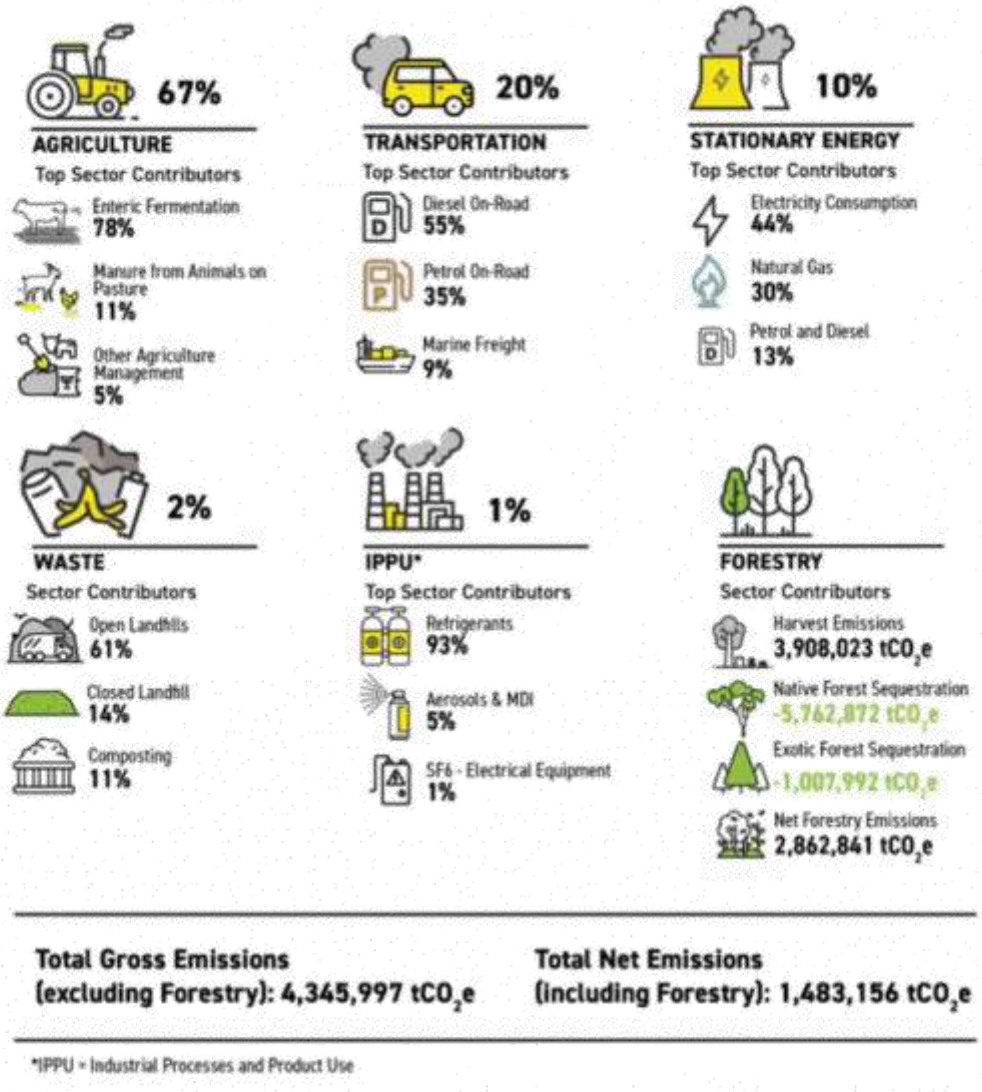

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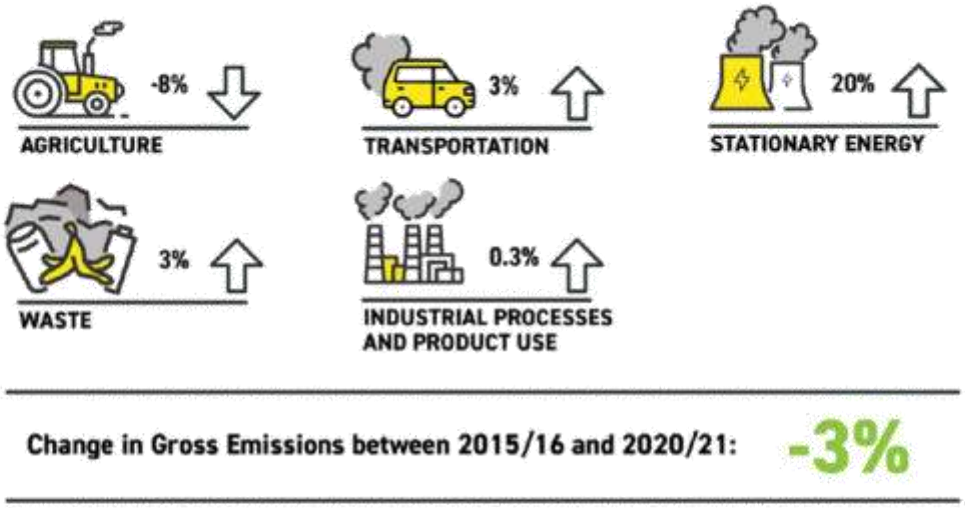
Figure 2: Change in Hawke's Bay Emissions Footprint between 2018/19 and 2020/21



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1.0 Introduction

AECOM New Zealand Limited (AECOM) was commissioned by the Hawke's Bay Regional Council to assist in the development of community-scale greenhouse gas (GHG) footprints for the Hawke's Bay for the 2018/19, 2019/20, and 2020/21 financial years. This is part of a wider study to develop community carbon footprints for each district within the Hawke's Bay region. Emissions are reported for the period from 1 July to 30 June for the respective years. The study boundary reported in the following pages incorporates the jurisdiction of the Hawke's Bay Regional Council.

The Hawke's Bay region is referred to hereafter as Hawke's Bay for ease. Greenhouse gas emissions are generally reported in this document in units of Carbon Dioxide Equivalents (CO_2e) and are referred to as 'emissions'.

2.0 Approach and Limitations

The methodological approach used to calculate emissions follows the Global Protocol for Community Scale Greenhouse Gas Emissions Inventory v1.1 (GPC) published by the World Resources Institute (WRI) 2021. The GPC includes emissions from Stationary Energy, Transport, Waste, Industrial Processes and Product Use (IPPU), Agriculture, and Forestry activities within the Region's boundary. The sector calculations for Agriculture, Forestry and Waste are based on Intergovernmental Panel on Climate Change (IPCC) workbooks and guidance for emissions measurement. The sector calculators also use methods consistent with GHG Protocol standards published by the WRI for emissions measurement when needed.

The same methodology has been used for other community scale GHG footprints around New Zealand, (e.g., Wellington, Auckland, Christchurch, Dunedin, and the Waikato region) and internationally. The GPC methodology[1] represents international best practice for city and regional level GHG emissions reporting.

This emissions footprint assesses both direct and indirect emissions sources. Direct emissions are production-based and occur within the geographic area (Scope 1 in the GPC reporting framework). Indirect emissions are produced outside the geographic boundary (Scope 2 and 3) but are allocated to the location of consumption. An example of indirect emissions is those associated with the consumption of electricity, which is supplied by the national grid (Scope 2). All other indirect emissions such as cross-boundary travel (e.g. flights) and energy transportation and distribution losses fit into Scope 3.

All major assumptions made during data collection and analysis have been detailed within **Appendix A – Assumptions**. The following aspects are worth noting in reviewing the emissions footprint:

- Emissions are expressed on a carbon dioxide-equivalent basis (CO_2e) including climate change feedback using the 100-year Global Warming Potential (GWP) values[2]. Climate change feedbacks are the climate change impacts from GHGs that are increased as the climate changes. For example, once the Earth begins to warm, it triggers other processes on the surface and in the atmosphere. Current climate change feedback guidance is important to estimate the long-term impacts of GHGs.
- GPC reporting is predominately production-based (as opposed to consumption-based) but includes some elements of consumption-based footprinting (e.g. indirect emissions from electricity consumption). Production-based emissions reporting is generally preferred by policy-makers due to robust established methodologies such as the GPC, which enables comparisons between different studies. Production-based approaches exclude globally produced emissions relating to consumption (e.g. embodied emissions relating to products produced elsewhere but consumed within the geographic area such as imported food products, cars, phones, clothes etc.).
- Total emissions are reported as both gross emissions (excluding Forestry) and net emissions (including Forestry).

[1] http://www.ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities
[2] https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf (Table 8.7)

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- Emissions for individual main greenhouse gases for each emissions source are provided in the supplementary spreadsheet information supplied with this report.
- Where location specific data were not accessible, information was calculated based on national or regional level data.
- Transport emissions:
  - Transport emissions associated with air travel, rail, and marine fuel were calculated by working out the emissions relating to each journey arriving or departing the area based on data provided by the relevant operators. Emissions for these sources are then split equally between the destination and origin. Emissions relating to a particular point source (e.g. an airport or port) are allocated to the expected users of that source, not just the area that it is located in. For example, in the Hawke's Bay Region, it is expected that all territorial authorities will use the Port of Tauranga for imported and exported goods, so emissions from this source have been allocated to all territorial authorities in the region based on population. It is understood that freight imports moving through the Port of Napier do not exclusively serve the Hawke's Bay Region, and freight exports do not exclusively originate from the Hawke's Bay Region, this should be considered when examining these emissions.
  - All other transport emissions are calculated using the fuel sold in the area (e.g. petrol, diesel, LPG).
- Solid waste emissions:
  - Solid waste emissions from landfill are measured using the IPCC First Order Decay method that covers landfill activity between 1950 and the present day.
  - Emissions are calculated for waste produced within the geographic boundary, even if they are transported outside the boundary to be entered into landfill.
  - An additional assessment of transport emissions related to the transport of landfill waste and recycled/diverted waste has been included in this assessment, outside of the GPC requirements for Community Carbon Footprints. Emissions were estimated based on the amount of material, distance transported from transfer station to next processing location, and the vehicles used. Any onward transport of materials post-processing have not been included.
- Wastewater emissions:
  - Emissions have been calculated based on the local data provided, following IPCC 2019 guidelines. Where data is missing, IPCC and Ministry for the Environment (MfE) figures have been used. Wastewater emissions from both wastewater treatment plants, and individual septic tanks have been calculated.
  - Wastewater emissions include those released directly from wastewater treatment, flaring of captured gas, and from discharge onto land/water.
- Industrial Processes and Product Use (IPPU) emissions:
  - IPPU emissions are estimated based on data provided in the New Zealand Greenhouse Gas Emissions 1990-2020 report (MfE 2022). Emissions are estimated on a per capita basis applying a national average per person.
- Forestry emissions:
  - This emissions footprint accounts for forest carbon stock changes from afforestation, reforestation, deforestation, and forest management (i.e. it applies land-use accounting conventions under the United Nations Framework Convention on Climate Change rather than the Kyoto Protocol). It treats emissions from harvesting and deforestation as instantaneous rather than accounting for the longer-term emission flows associated with harvested wood products.
  - The emissions footprint considers regenerating (growing) forest areas only. Capture of carbon from the atmosphere is negligible for mature forests that have reached a steady state.

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Overall sector data and results for the emissions footprint have been provided to the Hawke's Bay Regional Council in calculation table spreadsheets. All assumptions made during data collection and analysis have been detailed within **Appendix A – Assumptions**.

It is important to consider the level of uncertainty associated with the results, particularly given the different datasets used. Depending on data availability, national, regional, and local datasets are used across the different calculators. At the national level, New Zealand's Greenhouse Gas Inventory shows that for 2018 (the most recent national level inventory) an estimate of gross emissions uncertainty was +/- 9%, whereas a net emissions uncertainty estimate was +/- 12%. These levels of uncertainty should be considered when interpreting the results of this community carbon footprint (MfE, 2020).

StatsNZ Regional Footprint

Due to differences in emission factors and methodology used between the StatsNZ Regional Footprints and this community carbon footprint (based on the GPC requirements and available data), caution should be taken when making comparison of reported emissions. One example of this is where this footprint used updated emission factors for methane and nitrous oxide following guidance from the IPCC and in line with other Region and regional level GHG inventories in New Zealand. This difference is especially relevant for the Agriculture and Transport sectors.

Differences between the StatsNZ Regional Footprints and this community carbon footprint may be due to scope, coverage, data sources, and methods. The StatsNZ Regional Footprint approach is based on production, while the GPC methodology includes elements of consumption. The Stats NZ Regional Footprints use a residence approach, while GPC is based on the territory approach. The Stats NZ Regional Footprints also use global warming potentials from the IPCC Fourth Assessment Report, whilst this community carbon footprint uses global warming potentials from the IPCC Fifth Assessment Report.

Refer to the StatsNZ website for further information regarding StatsNZ Regional Footprint https://www.stats.govt.nz/methods/about-regional-greenhouse-gas-emissions-statistics/.

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3.0 Community Carbon Footprint for 2020/21

The paragraphs, figures and tables below outline the Hawke's Bay's greenhouse gas emissions, referred to as 'emissions' in this assessment. This includes The Hawke's Bay's total emissions, emissions from each sector, and major emissions sources within each sector. The focus of emissions reporting is on gross emissions.

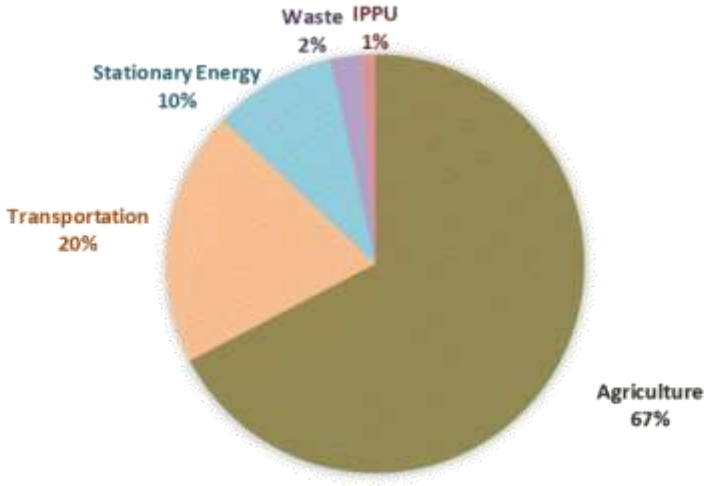
During the 2020/21 reporting period, Hawke's Bay emitted **gross** 4,345,997 tCO_2e. Note that gross emissions do not account for Forestry. Agriculture and Transport emissions are the largest contributors to total gross emissions for the Region.

The population of Hawke's Bay in 2020/21 was approximately 180,610 people, resulting in per capita gross emissions of 24.1 tCO_2e/person. Discussion of per capita emissions is limited to when it is useful for comparing emission figures against other territorial authorities. A breakdown of net emissions (i.e. including results from Forestry resources) is reported separately.

Table 1 Total net and gross emissions

Total emissions	tCO_2e
Total Net Emissions (including forestry)	1,483,156
Total Gross emissions (excluding forestry)	4,345,997

Figure 3: Hawke's Bay Region's total gross GHG emissions split by sector (tCO_2e).



During the 2020/21 reporting period, Hawke's Bay emitted **net** 1,483,156 tCO_2e.

Net emissions differ from gross emissions because they include emissions related to forestry activity (harvesting and planting) within an area. Forestry emissions are influenced by the cyclical nature of harvesting and planting regimes. In addition, with each subsequent planting of harvestable trees, there is a decreasing ebb and flow of sequestration.

Carbon sequestered by forestry can be viewed as a liability/risk that needs careful consideration. For example, if plantations are not replanted or other land use change occurs to exotic forested areas, then net emissions may rise quickly. Equally, if native forest is not protected from removal, and removal does happen, then net emissions may rise.

The community carbon footprint comprises emissions from six different sectors, summarised below:

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3.1 Agriculture

The highest emitting sector in Hawke's Bay, Agriculture, emitted 2,925,915 tCO_2e in 2020/21. Table 2 provides the emissions, percentage of total gross emissions, and percentage of the sector total for each sector/emissions source. Agricultural emissions are the result of both livestock and crop farming and do not include emissions relating to fuel or electricity consumption (reported in the Transport and Stationary Energy sectors).

Enteric fermentation from livestock produced 78% of Hawke's Bay's Agricultural emissions (2,274,432 tCO_2e). Enteric fermentation GHG emissions are produced by methane (CH_4) released from the digestive process of ruminant animals (e.g. cattle and sheep). The second largest source of agricultural emissions was produced from nitrous oxide (N_2O) released by unmanaged manure from grazing animals on pasture (332,570 tCO_2e or 11% of the Agricultural sector's emissions).

Table 2 Agriculture emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Enteric Fermentation	2,274,432	52.3%	77.7%
Manure from Grazing Animals on pasture	332,570	7.7%	11.4%
Other Agriculture Emissions	132,079	3.0%	4.5%
Atmospheric Deposition	93,329	2.1%	3.2%
Manure Management	47,822	1.1%	1.6%
Agricultural Soils	22,614	0.5%	0.8%
Fertiliser used in Horticulture	23,070	0.5%	0.8%
Total	**2,925,915**	**67%**	**100%**

Livestock were responsible for 96% of the Agriculture sector's GHG emissions (1,796,732 tCO_2e) (Table 3). Sheep account for 49% of agricultural emissions in the Hawke's Bay and 33% of the Hawke's Bay's total gross emissions. Non-dairy cattle account for 37% of agricultural emissions in the Hawke's Bay and 25% of the Hawke's Bay's total gross emissions.

Table 3 Agriculture emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Sheep	1,427,404	33%	49%
Non-dairy Cattle	1,072,780	25%	37%
Dairy Cattle	293,306	7%	10%
Other livestock	65,709	2%	2%
Fertiliser (other)	43,646	1%	1%
Fertiliser for Horticulture	23,070	1%	0.8%
Total	**2,925,915**	**67%**	**100%**

Fertilisers used for livestock and horticulture represent 4% of Agriculture emissions. An additional breakdown of emissions from fertiliser use in horticulture is included based on land-use information provided by HBRC covering the Hastings and Napier area only. Fertiliser use in horticulture represented 0.8% of the sector emissions. The largest contributor to 'Fertiliser for Horticulture' emissions in Hastings was sweetcorn (12,643 tCO_2e, 1.1% of Agricultural emissions) (displayed in Table 4). There is some

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potential for emissions double counting between the 'Fertiliser for Horticulture' and 'Fertiliser (other)' as these emissions have been calculated based on different datasets, where the 'Fertiliser (other)' category may also include some fertilisers used in horticulture. However, it is expected that the majority of the 'Fertiliser (other)' emissions are caused by fertiliser use for livestock land. Changes in soil carbon associated with horticulture have not been quantified due to absence of a defined appropriate method for assessing the carbon footprint associated with soil carbon change over time.

Table 4 Fertiliser for horticulture emissions by crop type

Sector / Emissions Source	tCO_2e	Hectares (Ha)
Sweetcorn	12,643	4,026
Pipfruit	2,380	4,829
Squash	2,188	1,736
Peas and Beans	1,479	2,791
Stonefruit	1,230	2,495
Beetroot	983	1,854
Grapes	910	5,351
Onions	839	482
Wheat	196	248
Kiwifruit	146	216
Grain	69	88
Tomato	7	82
Total	**23,070**	**24,197**

3.2 Transport

Transport, the second highest emitting sector in Hawke's Bay, produced 856,520 tCO_2e in 2020/21 (20% of the Hawke's Bay's gross total emissions). Table 5 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emissions source.

Table 5 Transport emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Diesel	472,063	10.9%	55.1%
Petrol	300,868	6.9%	35.1%
Marine Freight	78,488	1.8%	9.2%
Jet Kerosene	2,635	0.1%	0.3%
LPG	1,546	<0.1%	0.2%
Rail	647	<0.0%	0.1%
Aviation Gas	272	<0.1%	<0.1%
Total	**856,520**	**20%**	**100%**

Most of the transport emissions can be attributed to on and off-road diesel and petrol use, which collectively produced 90% of the sector's emissions and 18% of total gross emissions. Diesel and petrol transport emissions are broken down into on-road and off-road use. On-road transport consists of all standard transportation vehicles used on roads (including cars, trucks, buses, etc.). Off-road transport consists of all fuel used for the movement of machinery and vehicles off roads (including agricultural

tractors and vehicles, forklifts, etc.). On-road transport produced 681,394 tCO_2e (80% of Transport emissions). Off-road transport produced 93,084 tCO_2e (11% of Transport emissions).

The next largest Transport emission source is marine freight, which contributed to 9% of the sectors emissions and 2% of Hawke's Bay's total gross emissions (74,488 tCO_2e). Marine freight emissions are the result of freight movements to and from the Port of Napier. Emissions from this source have been divided between all territorial authorities in the Hawke's Bay region based on relative population sizes. It is understood that the imports and exports through this port are not exclusively related to activities in the Hawke's Bay region, however, to ensure that these emissions are reflected in community carbon footprints as per the GPC requirements this approach is appropriate.

The remaining transport emissions are attributed to air travel (jet kerosene and aviation gas), rail freight emissions and LPG use for transport (e.g. forklifts).

3.3 Stationary Energy

Producing 414,152 tCO_2e in 2020/21, Stationary Energy was The Hawke's Bay's third highest emitting sector (10% of total gross emissions). Table 6 provides the total emissions, percentage of total gross emissions, and percentage of the sector total for each sector/emissions source.

Electricity consumption was the cause of 44% of Stationary Energy emissions (181,396 tCO_2e), and 4% of The Hawke's Bay's total gross emissions. Electricity consumption emissions increase to 198,058 tCO_2e when including transmission and distribution losses related to that consumption.

Natural gas consumption accounted for 33% of the sector's emissions (135,607 tCO_2e) when including transmission and distribution losses. Stationary petrol and diesel consumption generated 13% of the sectors emissions (52,339 tCO_2e). Use of LPG, and the burning of coal, biofuels and biogas produced the remaining Stationary Energy emissions.

Table 6 Stationary Energy emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Electricity Consumption	181,396	4.2%	43.8%
Natural Gas	125,465	2.9%	30.3%
Stationary Petrol & Diesel Use	52,339	1.2%	12.6%
Electricity Transmission and Distribution Losses	16,663	0.4%	4.0%
LPG	12,261	0.3%	3.0%
Coal	10,343	0.2%	2.5%
Natural Gas Transmission and Distribution losses	10,143	0.2%	2.4%
Biofuel / Wood	5,447	0.1%	1.3%
Biogas	96	<0.1%	<0.1%
Total:	**414,152**	**10%**	**100%**

Stationary Energy demand can also be broken down by the sector in which it is consumed. Stationary Energy demand is reported for the following sectors: commercial; residential and industrial.

- Industrial Stationary Energy consumption accounts for 51% of Stationary Energy emissions (209,500 tCO_2e) and 5% of total gross emissions. Industrial Stationary Energy is energy used

within all industrial settings (including agriculture, forestry and fishing, mining, food processing, textiles, chemicals, metals, mechanical/electrical equipment and building and construction activities).

- Residential Stationary Energy consumption accounts for 20% of Stationary Energy emissions (82,378 tCO_2e) and 2% of total gross emissions. Residential Stationary Energy is energy used in homes (e.g. for heating, lighting, and cooking).
- Commercial Stationary Energy consumption accounts for 17% of Stationary Energy emissions (69,839 tCO_2e) and 2% of total gross emissions. Commercial Stationary Energy is energy used in all non-residential and non-industrial settings (e.g. in retail, hospitality, education, and healthcare).
- The remaining 13% of Stationary Energy emissions (52,435 tCO_2e, 1% of gross emissions) were produced by diesel and petrol, and the burning of biogas, which were not allocated to the above categories. Stationary Energy uses of diesel and petrol include stationary generators and motors and for heating.

3.4 Waste

Waste originating in Hawke's Bay (solid waste and wastewater) produced 99,459 tCO_2e in 2020/21, which comprises 2% of Hawke's Bay's total gross emissions. Table 7 provides the total emissions, percentage of total gross emissions, and percentage of the sector total for each sector/emissions source.

Table 7 Waste emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Waste in open landfill sites	60,295	1.4%	60.6%
Waste in closed landfill sites	13,743	0.3%	13.8%
Composting	11,125	0.3%	11.2%
Wastewater treatment plants	7,673	0.2%	7.7%
Individual septic tanks	6,623	0.2%	6.7%
Total:	**99,459**	**2%**	**100%**

Solid waste produced the bulk of Waste emissions (74,038 tCO_2e), making up 74% of total Waste emissions. Solid waste emissions include emissions from open landfills and closed landfills. Both open and closed landfills emit methane from the breakdown of organic materials disposed of in the landfill for many years after waste enters the landfill. Waste from Hawke's Bay sent to open landfill sites contributed 60,295 tCO_2e. Emissions from closed landfill sites produced 13,743 tCO_2e. Annual emissions from closed landfill sites will decrease over time as no new waste enters these sites.

Wastewater treatment (treatment plants and individual septic tanks) produced 14,296 tCO_2e making up 14% of total Waste emissions. Most of the households in Hawke's Bay are connected to wastewater treatments plants, which produced total emissions of 7,673 tCO_2e. Due to the production of methane, septic tanks have a higher emissions intensity compared to the wastewater treatments plants in Hawke's Bay. Households connected to individual septic tanks produced 6,623 tCO_2e in wastewater emissions.

Wastewater treatment tends to be a relatively small emission source compared to solid waste as advanced treatment of wastewater produces low emissions. In contrast, solid waste generates methane gas over many years as organic material enters landfill.

Composing produced 11,125 tCO_2e making up 11% of total Waste emissions. Waste diverted from landfill for composting in the Hawke's Bay Region includes horticultural, animal waste products, green waste, bark and sawdust.

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3.5 Industrial Processes and Product Use (IPPU)

IPPU in Hawke's Bay produced 49,950 tCO_2e in 2020/21, contributing 1% to Hawke's Bay's total gross emissions. This sector includes emissions associated with the production of GHGs for refrigerants, foam blowing, fire extinguishers, aerosols, metered dose inhalers and Sulphur Hexafluoride for electrical insulation and equipment production. IPPU emissions do not include energy use for industrial manufacturing, which is included in the relevant Stationary Energy sub-category (e.g. coal, electricity and/or petrol and diesel). These emissions are based on nationally reported IPPU emissions and apportioned based on population due to the difficulty of allocating emissions to particular geographic locations.

There are no known industrial processes (as defined in the GPC requirements) present in the Hawke's Bay (e.g. aluminium manufacture).

Table 8 provides the total emissions, percentage of total gross emissions, and percentage of the sector's total for each sector/emissions source. The most significant contributor to IPPU emissions is the use of refrigerants which produced 93% of IPPU emissions (46,441 tCO_2e).

Table 8 Industrial processes and product use emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Refrigerants and air conditioning	46,441	1.1%	93.0%
Aerosols	2,601	0.1%	5.2%
SF6 - Electrical Equipment	508	<0.1%	1.0%
Foam Blowing	220	<0.1%	0.4%
SF6 - Other	100	<0.1%	0.2%
Fire extinguishers	80	<0.1%	0.2%
Total	**49,950**	**1.0%**	**100%**

3.6 Forestry

Planting of native forest (e.g. mānuka and kānuka) and exotic forest (e.g. pine), sequesters (captures) carbon from the atmosphere while the trees are growing to maturity. Harvesting of forest releases emissions via the release of carbon from organic matter and soils following harvesting. When sequestration by forests exceeds emissions from harvesting, the extra quantity of carbon sequestered by forest reduces net Forestry emissions. Conversely when emissions from harvesting exceed the amount of carbon sequestered by native and exotic forests, then net Forestry emissions will increase.

Sequestration in 2020/21 was 6,770,864 tCO_2e (which was mostly from exotic forests) while harvesting emissions were 3,908,023 tCO_2e. This meant that Forestry in Hawke's Bay was a net negative source of emissions in 2020/21 (rather than a positive source of emissions, where harvesting exceeds sequestration). Total Forestry emissions in 2020/21 were -2,862,841 tCO_2e. It is noted that harvesting of exotic forest can be cyclical in nature where some years will have higher sequestration and some years will have higher harvesting emissions determined by age of forests, commercial operators, and the global market.

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Table 9 Forestry emissions by emission source (including sequestration)

Sector / Emissions Source	tCO_2e
Total harvest emissions	3,908,023
Native forest sequestration	-1,007,992
Exotic forest sequestration	-5,762,872
Total	**-2,862,841**

3.7 Total Gross Emissions by Greenhouse Gas

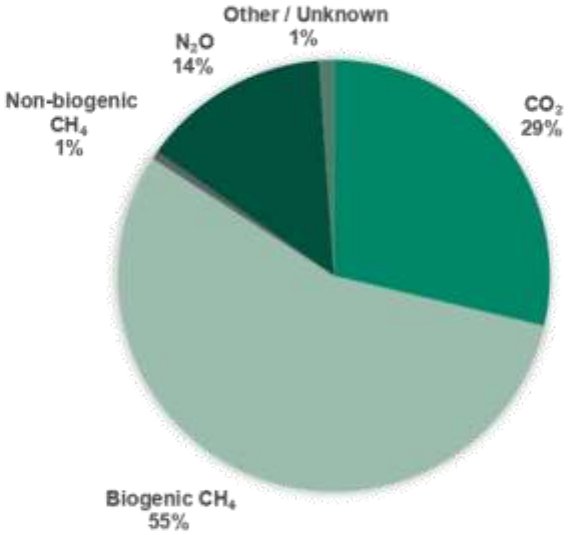
Each greenhouse gas has a different level of impact on climate change, this is accounted for when converting quantities of each gas into units of carbon dioxide equivalent (CO_2e).

Table 10: Hawke's Bay's total gross emissions, by greenhouse gas

Greenhouse Gas	Tonnes	Tonnes of CO_2e
Carbon Dioxide (CO_2)	1,248,710	1,248,710
Biogenic Methane (CH_4)	70,814	2,407,693
Non-biogenic Methane (CH_4)	795	27,030
Nitrous Oxide (N_2O)	2,060	613,673
Other / Unknown Gas (in CO_2e)	48,891	48,891
Total	**1,369,680**	**4,345,997**

Figure 4 illustrates the Hawke's Bay's total gross emissions by greenhouse gas in units of carbon dioxide equivalents (CO_2e).

Figure 4: The Hawke's Bay Region's total gross emissions, by greenhouse gas (in tCO_2e)



Due to the greater global warming impact of methane, methane represents just 5% of the total tonnage of GHG emissions from the Hawke's Bay but represents 55% of CO_2e. Nitrous oxide represents 0.2% of the total tonnage of GHG emissions from Hawke's Bay but represents 14% of CO_2e. This effect can be seen in Figure 5.

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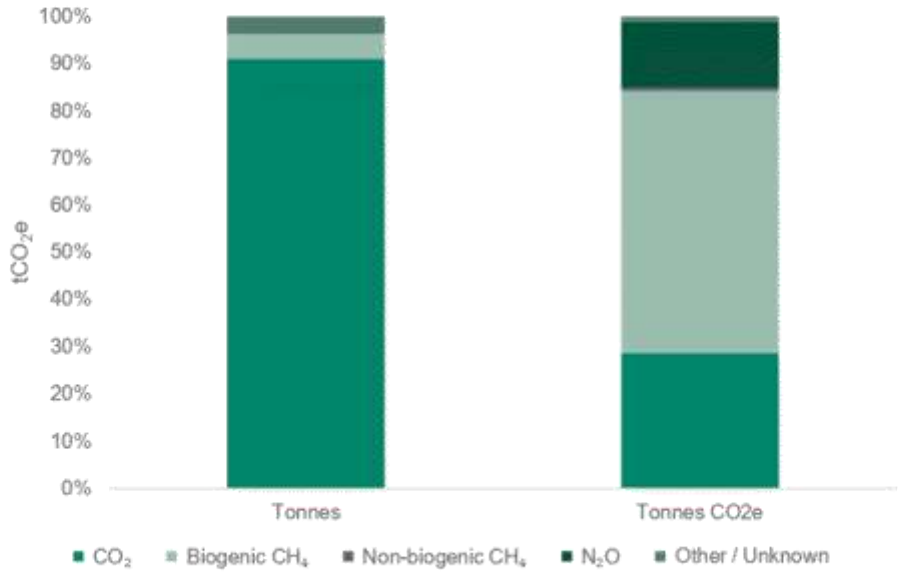
Figure 5: Hawke's Bay Region's total gross emissions, by greenhouse gas in tonnes and in tonnes of CO_2e



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3.8 Biogenic emissions

Biogenic carbon dioxide and methane emissions are stated in Table 11 and Table 12, respectively.

Biogenic CO_2 emissions are those that result from the combustion of biomass materials that store and sequester CO_2, including materials used to make biofuels (e.g. trees, crops, vegetable oils, or animal fats). Biogenic CO_2 emissions from plants and animals are excluded from gross and net emissions as they are part of the natural carbon cycle.

Table 11: Biogenic CO_2 in the Hawke's Bay (Excluded from gross emissions)

Biogenic Carbon Dioxide (CO_2) (Excluded from gross emissions)		
Biofuel	178,324	t CO_2
Combusted Landfill Gas	14,793	t CO_2
Total Biogenic CO_2	**193,117**	**t CO_2**

Biogenic CH_4 emissions (e.g., produced by farmed cattle via enteric fermentation) are included in gross emissions due to their relatively large impact on global warming relative to biogenic CO_2. Biogenic methane represents 5% of the gross total tonnage of GHG emissions in the Hawke's Bay but represents 55% of total gross GHG emissions when expressed in CO_2e. This is caused by the higher global warming impact of methane per tonne, compared to carbon dioxide. The total tonnage of each GHG and the contribution of each GHG to total gross emissions when expressed in CO_2e is shown in Table 10.

The importance of biogenic CH_4 is highlighted in NZ's Climate Change Response (Zero Carbon) Amendment Act. The Act includes specific targets to reduce biogenic CH_4 by between 24% and 47% below 2017 levels by 2050, and by 10% below 2017 levels by 2030. More information on the Act is available here: https://www.mfe.govt.nz/climate-change/zero-carbon-amendment-act.

Table 12: Biogenic Methane in the Hawke's Bay (Included in gross emissions)

Biogenic Methane (CH_4) (Included in gross emissions)		
Enteric Fermentation	66,895	t CH_4
Landfill Gas	2,177	t CH_4
Manure Management	1,407	t CH_4
Wastewater Treatment	404	t CH_4
Composting (Green Waste)	190	t CH_4
Biofuel	143	t CH_4
Total Biogenic CH_4	**71,217**	**t CH_4**

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3.9 Territorial Authorities in the Hawke's Bay Region

The Hawke's Bay regional area contains several territorial authorities. Hastings District, Napier City, Central Hawkes Bay District, and Wairoa District are all exclusively within the boundaries of the Hawke's Bay region. Additionally, areas of Taupō District and Rangitīkei District are also part of the Hawke's Bay region. We estimate that 0.1% of Taupō's population and 12% of Taupō's area, and 0.3% of Rangitīkei's population and 14% of Rangitīkei's area are within the Hawke's Bay region.

Figure 6 shows the Hawke's Bay's total gross emissions divided by territorial authority. Figure 7 shows total gross emissions for the territorial authorities in the Hawke's Bay Region, split by sector. Both figures only include the emissions produced within the Hawke's Bay region for Taupō and Rangitīkei.

Hastings is the highest emitting territorial authority in the region, representing 43% of the Hawke's Bay's total gross emissions. Hastings' emissions inventory is predominantly agriculture-related emissions with the next largest emitting territorial authorities; Central Hawke's Bay and Wairoa, also containing significant agricultural emissions. Of the four territorial authorities entirely within the Hawke's Bay region, Napier has the lowest total gross emissions, with emissions mostly from Transport and Stationary Energy. The areas of Taupō and Rangitīkei contribute to 2% of the Hawke's Bay region's total gross emissions, almost entirely from Agriculture.

Figure 6 Hawke's Bay's total gross emissions divided by territorial authority (tCO_2e). *Taupō and Rangitīkei totals only include emissions produced in the Hawke's Bay region.

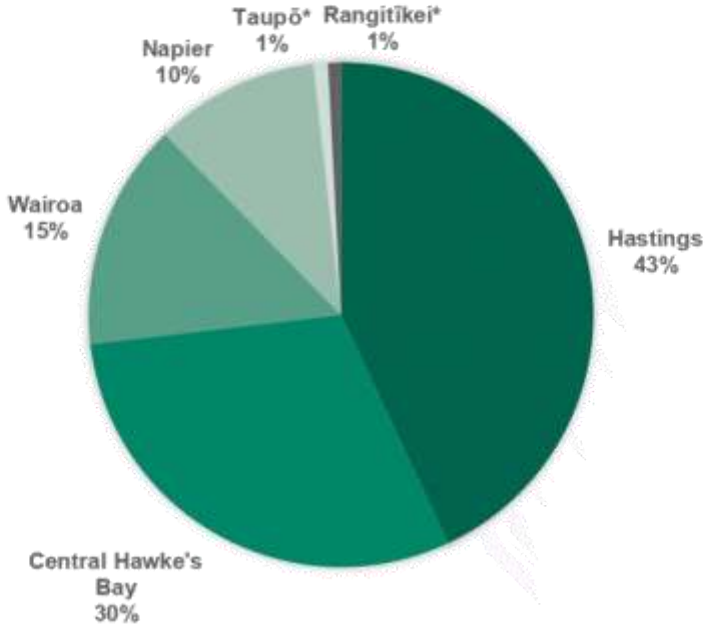

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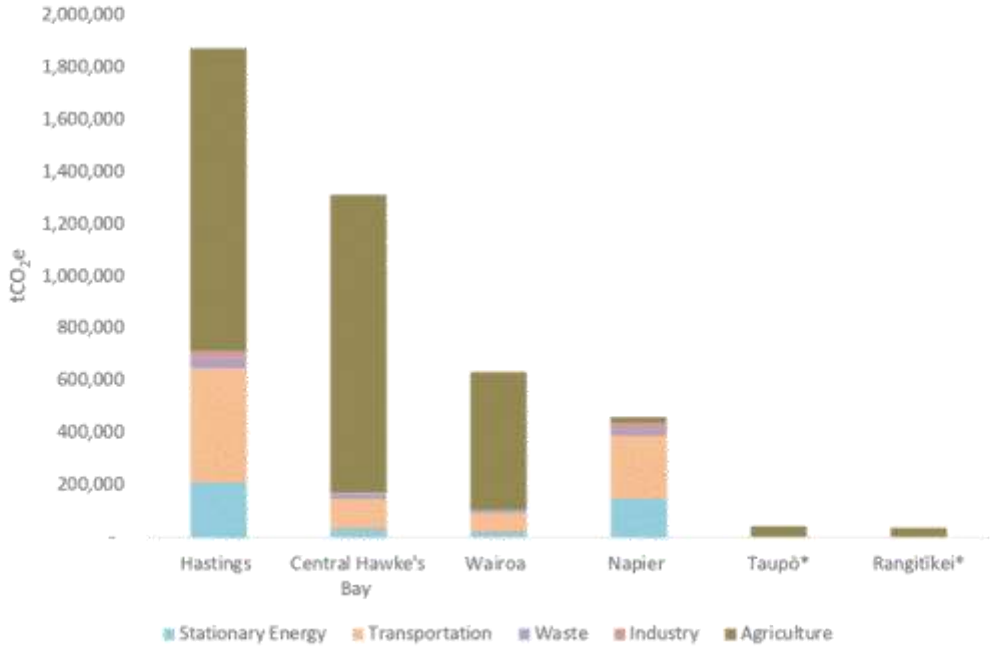
Figure 7 Total gross emissions by territorial authority in the Hawke's Bay region (tCO_2e). *Taupō and Rangitīkei totals only include emissions produced in the Hawke's Bay region.



When comparing emissions inventories from different areas, a per capita figure can be useful because it provides a common reference point to understand the difference in emissions. Figure 8 shows emissions per capita for the region and territorial authorities within the region. Taupō and Rangitīkei are excluded from this figure due to the tiny population and large agriculture within the small area in the Hawke's Bay creating very large per capita emissions (this is not the case for the entire Taupō or Rangitīkei district).

The Hawke's Bay region has a 24.1 tCO_2e/per capita figure for total gross emissions which is higher than the national value of 15.7 tCO_2e/per capita. Notably, Napier has the lowest per capita total emissions at 6.9 tCO_2e/per capita. Central Hawke's Bay and Wairoa have the largest per capita total gross emissions at 84.6 tCO_2e/per capita and 70.3 tCO_2e/per capita respectively, both due to high Agriculture emissions in the district. Hastings has the third highest per capita emissions at 20.9 tCO_2e/per capita, similar to that of the region.

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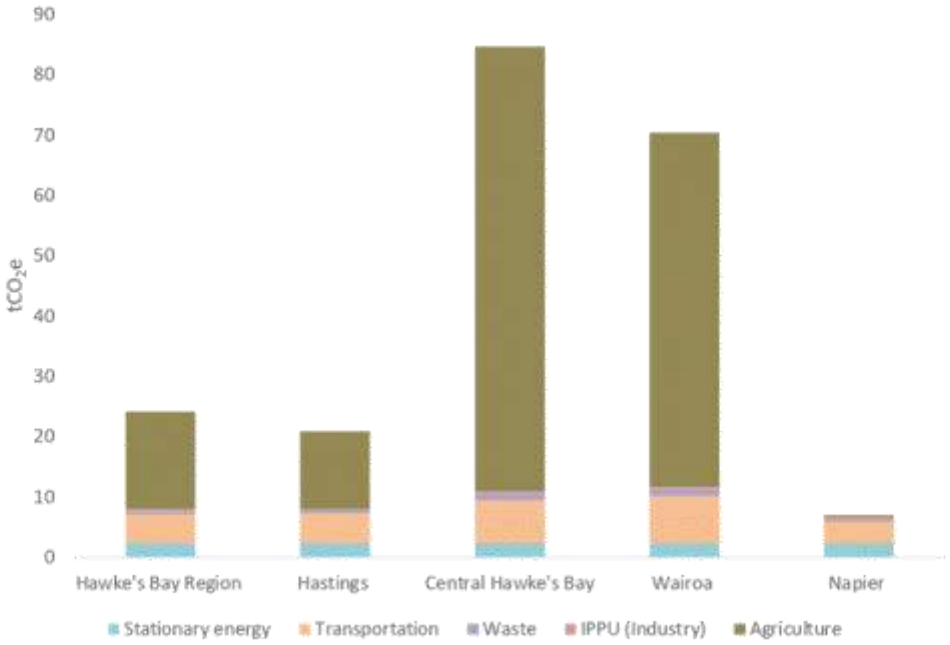
Figure 8 Total gross emissions per capita for the region and territorial authorities within the region (tCO_2e). *Taupō and Rangitīkei areas not included



4.0 Emissions change from 2018/19 to 2020/21

Alongside calculating The Hawke's Bay's emissions footprint for 2020/21, we have calculated the Hawke's Bay's emissions footprint for 2018/19 and 2019/20. This section displays the results of the 2018/19, 2019/20, and 2020/21 emissions footprints with a focus on Gross emissions and documents the change in emissions from 2018/19 to 2020/21.

This section displays the results of the 2018/19, 2019/20, and 2020/21 emissions footprints with a focus on Gross emissions and documents the change in emissions from 2018/19 to 2020/21.

Table 13 Change in The Hawke's Bay's Total Gross and Net emissions from 2018/19 to 2020/21

	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Total Net Emissions (including forestry)	1,855,570	1,413,954	1,483,156	-20%
Total Gross Emissions (excluding forestry)	4,497,263	4,155,767	4,345,997	-3%

https://aecom.sharepoint.com/sites/HBRCCCFFY19-FY21/Shared Documents/General/4. Deliverables/220923 Final Reports/HBRC_CommunityCarbonFootprint_2022_HawkesBayRegion_220923_Final.docx
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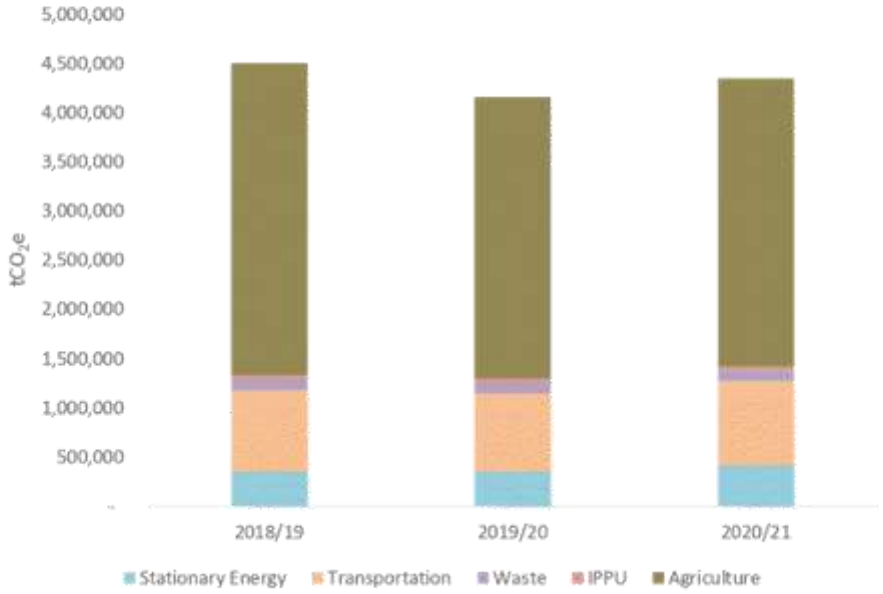
Figure 9 Change in The Hawke's Bay's total gross emissions from 2018/19 to 2020/21



Total gross emissions per year decreased by 3% from 4,497,263 tCO_2e in 2018/19 to 4,345,997 tCO_2e in 2020/21. This was driven by a decrease in Agricultural emissions of 8%, between 2018/19 and 2020/21 (245,553 tCO_2e), due to a reduction in livestock numbers, particularly of sheep and non-dairy cattle.

Total net emissions in Hawke's Bay decreased by 20% from 1,855,570 in 2018/19 to 1,483,156 tCO_2e. This decrease was predominantly due to a decrease in annual forest harvesting emissions. This is discussed further below under the 'Forestry' heading.

The population of Hawke's Bay grew by 4% during this time, resulting in a 7% reduction in per capita gross emissions between 2018/19 and 2020/21, from 25.9 to 24.1 tCO_2e per person per year. A discussion of the decoupling of gross emissions from population growth and economic growth is found in Section 5.0.

The sections below outline the change in emissions between 2018/19 and 2020/21 for each sector and emissions source, highlighting the changes that have had the largest impact on total gross emissions.

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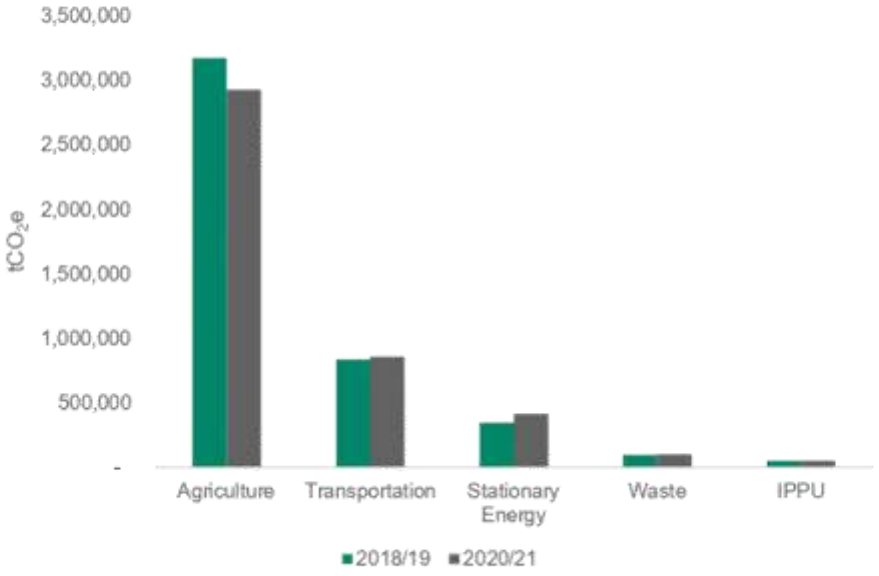
Figure 10 Emissions for each sector of The Hawke's Bay's gross emissions footprint for 2018/19 and 2020/21



4.1 Agriculture

Table 14 Change in Hawke's Bay's Agriculture emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Enteric fermentation	2,457,058	2,219,534	2,274,432	-7%
Manure from Grazing Animals	360,412	324,471	332,570	-8%
Other Agriculture Emissions	147,558	132,002	132,079	-10%
Atmospheric Deposition	101,881	91,618	93,329	-8%
Manure Management	51,814	47,881	47,822	-8%
Agricultural Soils	29,657	25,712	22,614	-24%
Fertiliser used in Horticulture	23,070	23,070	23,070	*N/A*
Total	**3,171,449**	**2,864,287**	**2,925,915**	**-8%**

Agriculture is the most significant contributor to the Hawke's Bay's community carbon footprint. The sector's emissions decreased by 8% between 2018/19 and 2020/21 (245,533 tCO_2e). This decrease is driven by a reduction in total livestock numbers, especially of dairy cattle and sheep (see Table 15 and Table 16.

Emissions related to sheep decreased by 149,172 tCO_2e due to a reduction in the number of sheep (272,146 sheep). Emissions related to non-dairy cattle decreased by 60,255 tCO_2e due to a reduction in the number of non-dairy cattle (30,490 cattle). The number of dairy cattle also reduced, reducing dairy cattle emissions by 20,394 tCO_2e.

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Table 15 Change in The Hawke's Bay's livestock numbers from 2018/19 to 2020/21

	Number of animals (2018/19)	Number of animals (2020/21)	Change in number of animals (2018/19 to 2020/21)
Sheep	2,876,262	2,604,116	-272,146
Non-dairy Cattle	448,764	418,274	-30,490
Dairy Cattle	78,002	72,208	-5,794
Other livestock	71,257	71,414	157
Total livestock	**3,474,285**	**3,166,012**	**-308,273**

Table 16 Change in the Hawke's Bay's livestock-associated Agriculture emissions from 2018/19 to 2020/21

	2018/19 emissions (tCO_2e)	2020/21 emissions (tCO_2e)	Change in emissions, 2018/19 to 2020/21 (tCO_2e)
Sheep	1,576,576	1,427,404	-149,172
Non-dairy Cattle	1,133,035	1,072,780	-60,255
Dairy Cattle	313,700	293,306	-20,394
Other livestock	67,427	65,709	-1,718
Total livestock	**3,090,738**	**2,859,199**	**-149,172**

4.2 Transport

Table 17 Change in Hawke's Bay's Transport emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Diesel	433,808	421,738	472,063	9%
Petrol	301,531	281,543	300,868	0%
Marine Freight	90,698	90,634	78,488	-13%
Jet Kerosene	3,820	3,293	2,635	-31%
Rail	3,160	861	647	-80%
LPG	1,460	1,477	1,546	6%
Aviation Gas	222	265	272	23%
Total:	**834,698**	**799,813**	**856,520**	**3%**

Transport emissions increased by 3% between 2018/19 and 2020/21 (21,822 tCO_2e). This was driven by a 5% increase in on-road fuel emissions (30,363 tCO_2e) combined with a 13% decrease in marine freight emissions (12,210 tCO_2e).

It is noted the impact of the COVID-19 pandemic can be seen in Transport emissions where emissions decreased by 4% between 2018/19 and 2019/20 due to reductions in road and air transport fuel use. Aviation emissions continued to reduce in the 2020/21 reporting year, reflective of ongoing COVID-19 impacts to the industry.

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4.3 Stationary Energy

Table 18 Change in Hawke's Bay's Stationary Energy emissions from 2018/19 to 2020/21

Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Electricity Consumption	125,197	129,010	181,396	45%
Natural Gas	120,436	117,023	125,465	4%
Stationary Petrol & Diesel Use	48,276	46,850	52,339	8%
Coal	12,690	13,259	10,343	-18%
LPG	11,573	11,713	12,261	6%
Electricity Transmission and Distribution Losses	10,931	11,308	16,663	52%
Natural Gas Transmission and Distribution Losses	9,737	9,461	10,143	4%
Biofuel / Wood	5,414	5,424	5,447	1%
Biogas (landfill)	92	93	96	4%
Total:	**344,347**	**344,141**	**414,152**	**20%**

Emissions from Stationary Energy increased by 20% between 2018/19 and 2020/21 (69,806 tCO_2e). This was driven by a 45% increase in electricity consumption emissions (56,198 tCO_2e). This rise in electricity consumption emissions was caused by a 3% increase in electricity consumption in the Hawke's Bay coupled with a 41% increase in the emissions intensity of the national electricity grid (tCO_2e/kWh). The emissions intensity of the national grid has increased in recent years due to the increased use of fossil fuels during years with low hydro electricity generation.

4.4 Waste

Table 19 Change in Hawke's Bay's Waste emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Waste in open landfill sites	57,126	58,590	60,295	6%
Waste in closed landfill sites	15,380	14,533	13,743	-11%
Individual septic tanks	5,655	6,199	6,623	17%
Wastewater treatment plants	7,682	7,240	7,673	0%
Composting	11,125	11,125	11,125	0%
Total	**96,968**	**97,686**	**99,459**	**3%**

Waste emissions increased between 2018/19 and 2020/21, by 3% (2,491 tCO_2e). Total solid waste in landfill emissions increased by 2%. Emissions from closed landfills decreased due to no extra waste being added, the existing waste in landfill releases fewer emissions over time. Emissions from waste in

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open landfills increased as the volume of waste entering the landfill increased, and waste recently deposited in landfill reaches peak emissions per year (this is after approximately two years in landfill). Due to data only being available for one singular year, no change in composting emissions is recorded.

Total wastewater emissions increased by 7%, due to the increase in emissions from individual septic tanks (968 tCO_2e). Better data on the number of households connected to centralized wastewater treatment would improve the accuracy of the emissions calculations. Due to the production of methane, septic tanks have a higher emissions intensity compared to a wastewater treatment plant.

4.5 Industrial Processes and Product Use (IPPU)

Table 20 Change in Hawke's Bays IPPU emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Refrigerants and air conditioning	46,065	46,242	46,441	1%
Aerosols	2,899	2,707	2,601	-10%
SF6 - Electrical Equipment	457	493	508	11%
Foam Blowing	202	219	220	9%
SF6 - Other	99	99	100	1%
Fire extinguishers	80	80	80	0%
Total	**49,802**	**49,840**	**49,950**	**0.3%**

IPPU emissions remained stable between 2018/19 and 2020/21. There was a decrease in aerosols emissions (298 tCO_2e) and an increase in refrigerants and air conditioning (376 tCO_2e). Note that national level data is used for this sector and is portioned out using a population approach; exact emissions for the Region are unknown.

4.6 Forestry

Table 21 Change in Hawke's Bays Forestry emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Total harvest emissions	4,026,465	3,945,810	3,908,023	-3%
Native forest sequestration	-1,007,992	-1,007,992	-1,007,992	0%
Exotic forest sequestration	-5,660,165	-5,679,631	-5,762,872	2%
Total	-2,641,693	-2,741,813	-2,862,841	8%

Forestry emissions decreased by 221,148 tCO_2e (8%) between 2018/19 and 2020/21. This decrease was driven by a decrease in total harvest emissions (118,442 tCO_2e) and an increase in exotic forest sequestration during this time. Forestry emissions are influenced by the cyclical nature of harvesting and planting regimes where some years will have higher sequestration and some years will have higher harvesting emissions. This is dependent on age of forests and the demand for lumber and timber. Improved and updated data sources may impact the estimation of emissions from this source in the future.

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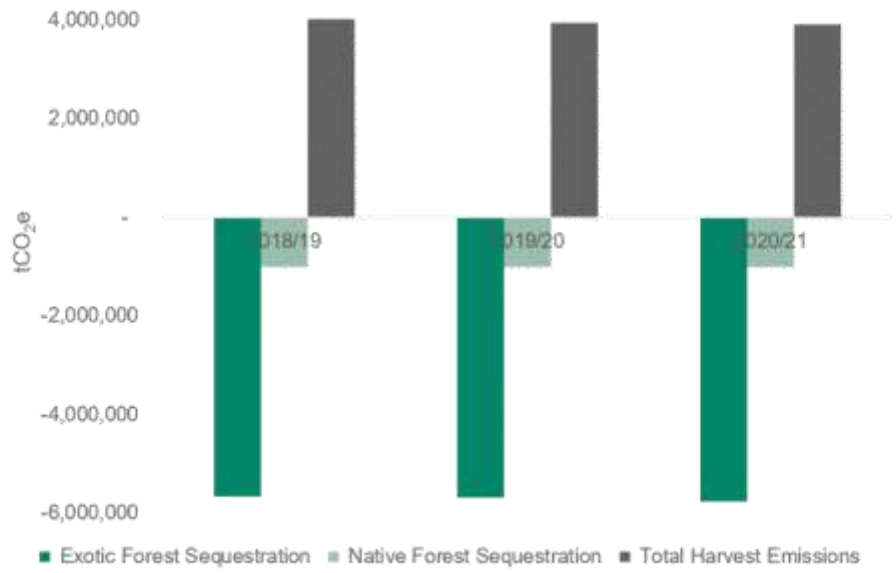
Figure 11 Forestry sequestration and harvesting emissions from 2018/19 to 2020/21



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5.0 Decoupling of GHG emissions from population growth and GDP

Figure 12 shows the change in gross emissions when compared to changes in other metrics of interest between 2018/19 and 2020/21. For example, total gross emissions have decreased by 3% as the population has grown by 4%, resulting in a 7% decrease in per capita gross emissions.

When emissions grow less rapidly than Gross Domestic Product (GDP) as a measure of regional income then this process is known as decoupling. The term decoupling is an expression of the desire to mitigate emissions without harming economic wellbeing. A full discussion of decoupling of emissions is beyond the scope of this project. However, the changes in emissions and GDP illustrated in Figure 12 suggest at a high-level decoupling has occurred between 2018/19 and 2020/21. GDP increased by 7% while gross emissions decreased by 3%, resulting in a 10% decrease in the GHG emissions ratio to GDP.

The exact drivers for the decoupling of emissions from GDP are difficult to pinpoint. New policies, for restructuring the way to meet demand for energy, food, transportation, and housing will all contribute. In this case, both direct local actions including reducing the emissions from landfill gas and indirect national trends (e.g. reduction of emissions from electricity generation) will have contributed to the trends noted.

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Figure 12 Change in total gross emissions compared to other metrics of interest

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6.0 Impact of the COVID-19 pandemic on GHG Emissions

COVID-19 impacted New Zealand and the entire world during 2020 and 2021, causing widespread government-imposed restrictions on businesses and individuals and huge shifts in behaviours and economic markets. Restrictions in New Zealand relating to COVID-19 began in mid-March 2020 with many personal and business restrictions continuing past the end of 2019/20 and throughout 2020/21.[3]

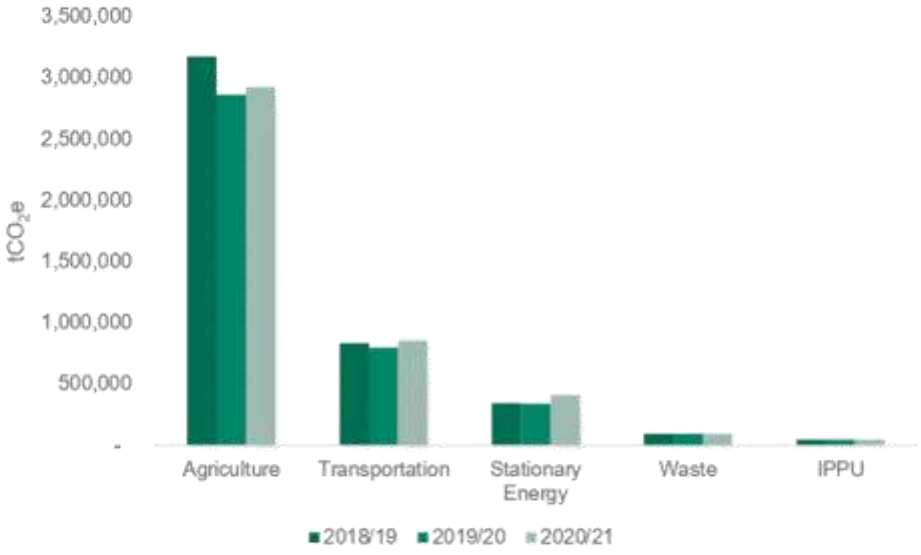
Globally, carbon dioxide emissions from fossil fuels (the largest contributor to greenhouse gas emissions) in 2020 decreased by 7% compared to 2019[4]. Emissions from the transportation sector account for the largest share of this decrease. Surface transport, e.g. car journeys, fell by approximately half at the peak of COVID-19 restrictions in April 2020 (when restrictions were at their maximum, particularly across Europe and the U.S. Globally, emissions recovered to near 2019 levels in 2021 and are expected to continue to increase.

In New Zealand, national daily carbon dioxide emissions are estimated to have fell by up to 41% during the level 4 lockdown in April 2020[5]. National gross emissions decreased by 3% from 2018/19 to 2019/20, which was largely driven by a decrease in fuel use in road transport due to COVID-19 pandemic restrictions, a decrease in fuel use in manufacturing industries and construction due to COVID-19 restrictions, and a decrease in fuel use from domestic aviation also due to COVID-19 restrictions.

Total gross emissions in the Hawke's Bay decreased by 341,496 tCO_2e (8%) between 2018/19 and 2019/20. Total gross emissions then increased by 190,229 tCO_2e (4%) from 2019/20 to 2020/21, however this is still lower than the pre-covid-19 2018/19 year.

The impact on emissions in different sectors varied. Notably, Transport emissions reduced by 4% between 2018/19 and 2019/20, driven by reduced on-road and off-road transport fuel use. Agriculture emissions reduced between 2018/19 and 2019/20, potentially due to impacts on transport and global supply chains. Despite changes in Stationary Energy emissions, this sector is not judged to have been significantly affected by COVID-19. Waste and IPPU emissions were relatively unchanged between 2018/19 and 2019/20.

Figure 13 Hawke's Bay emissions per sector for 2018/19, 2019/20, and 2020/21 (tCO_2e)



[3] https://covid19.govt.nz/alert-system/history-of-the-covid-19-alert-system/
[4] Pierre Friedlingstein et al. - Global Carbon Budget 2020 (2020)
[5] Corinne Le Quere et al. – Temporary Reduction in Daily Global CO_2 Emissions During the COVID-19 Forced Confinement

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7.0 Closing Statement

The Hawke's Bay GHG emissions footprint provides information for decision-making and action by the council, stakeholders, and the wider community. We encourage the council to use the results of this study to update current climate actions plans and set emission reduction targets.

The emissions footprint developed for the Hawke's Bay region covers emissions produced in the Stationary Energy, Transport, Waste, IPPU, Agriculture, and Forestry sectors using the GPC reporting framework. Sector-level data allows the Hawke's Bay Regional Council to target and work with the sectors that contribute the most emissions to the footprint.

Understanding of the extensive and long-lasting effects of climate change is improving all the time. It is recommended that this emissions footprint be updated regularly (every two or three years) to inform ongoing positive decision making to address climate change issues.

The accuracy of any emissions footprint is limited by the availability, quality, and applicability of data. Areas where data could be improved for future footprints include forestry (forest cover and harvesting), agriculture (especially livestock numbers), solid waste and wastewater, and on and off-road transport fuel use.

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8.0 Limitations

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Appendix A

Assumptions and Data Sources

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Sector / Category	Assumption and Data Sources
General	
Geographical Boundary	LGNZ local council mapping boundaries have been applied. The emissions footprint for the Hawke's Bay Region covers the entirety of the Hawke's Bay Region (this excludes some of the Rangitikei and Taupō territorial authorities). Emissions footprints for each territorial authority covers the entirety of the territorial authority area.
Population	Population figures are provided by StatsNZ. Financial year populations have been used, these are based on the average population from the two calendar years (e.g. the average of 2018 and 2019 calendar year populations for FY19). The population of Taupo and Rangitikei Districts within the Hawke's Bay geographical boundary has been calculated.
Transport Emissions	
Petrol and Diesel:	Petrol and diesel sales data provided by Napier City Council for Napier, Central Hawke's Bay and Hastings. Combined sales data for Gisborne and Wairoa provided by Gisborne District Council and allocated to a region based on Waka Kotahi emissions data. Sales have been divided between territorial authorities based on the number of kilometres travelled by vehicles on roads (VKT) in each territorial authority. VKT data provided by Waka Kotahi. The division into transport and stationary energy end use (and within transport into on-road and off-road) has been calculated using fuel end use data provided by the Energy Efficiency and Conservation Authority (EECA) from the 2019 database. Biofuel sales information provided directly by the supplier.
Rail Diesel	Emissions from fuel use have been calculated and provided by Kiwi Rail. The following assumptions were made: - Net Weight is product weight only and excludes container tare (the weight of an empty container) - The Net Tonne-Kilometres (NTK) measurement has been used. NTK is the sum of the tonnes carried multiplied by the distance travelled. - National fuel consumption rates have been used to derive litres of fuel for distance. - Type of locomotive engine used, and jurisdiction topography, have not been incorporated in the calculations. The trans-boundary routes were determined, and the number of stops taken along the way derived. The total amount of litres of diesel consumed per route was then split between the departure district, arrival district and any district the freight stopped at along the way. If the freight travelled through but did not stop within a district, no emissions were allocated. This data is subject to commercial confidentiality.
Jet Kerosene (Scheduled Flights) Aviation Gas (General Aviation)	Calculated from information provided by Hawke's Bay Airport. Aviation fuel and jet kerosene fuel volumes were provided and emissions have been calculated using these volumes. Emissions have been divided between territorial authorities based the relative population of each territorial authority.

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Marine Freight	Shipping schedules have been provided by the Port of Napier. Emissions have been calculated based on ship weight and distance from the origin/destination to Napier. This figure does not include fishing vessels, or vessels with destination to be confirmed. Emissions from freight and international shipping are allocated equally between the origin and destination area emissions footprints. It is expected that imports and exports travelling through the Port of Napier service the entire Hawke's Bay Region. Emissions relating to freight and international shipping emissions have been divided between all Hawke's Bay territorial authorities based on population size.
Marine Fuel (Local)	Non-freight marine fuel use has not been included in this study. Fuel use by Port of Napier-controlled vessels has not been included due to a lack of available information. Most private marine vessels use fuel purchased at vehicle fuel stations. Petrol and diesel used in private marine vessels is included in off-road transportation.
LPG Consumption	North Island LPG sales data (tonnes) has been provided by the LPG Association. 'Auto' and 'Forklift' sales represent transport uses of LPG. Sales have been divided between territorial authorities on a per capita basis.
Stationary Energy Emissions	
Electricity Demand	Electricity demand has been calculated using grid exit point (GXP) data from the EMI website (www.emi.ea.govt.nz). Reconciled demand has been used as per EMI's confirmation. The territorial authorities serviced by each GXP have been confirmed by the respective electricity suppliers. The breakdown into sectors (Residential, Commercial, and Industrial) is based on NZ average consumption per sector as per Ministry for the Environment (MfE) data.
Electricity Generation	Electricity generation has been calculated using data from the EMI website (www.emi.ea.govt.nz). Small electricity generation has not been included in this data (e.g. domestic solar generation). This figure only includes electricity that is connected to the national electricity grid, direct users of electricity are not included.
Coal Consumption	National coal consumption data has been provided by MBIE. Regional industrial coal data has been provided by EECA. National residential and commercial coal consumption has been divided between territorial authorities on a per capita basis. Regional industrial coal consumption has been divided between territorial authorities on a per capita basis.
Coal Production and Fugitive Emissions	Not Calculated: There are no active coal mines within the region.
Biofuel Consumption	National biofuel consumption data has been provided by the Ministry for Business, Innovation and Employment (MBIE). Biofuel consumption has been divided between territorial authorities on a per capita basis. Biofuel emissions are broken down into Biogenic emissions (CO_2) and Non-Biogenic emissions (CH_4 and N_2O)

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LPG Consumption	North Island LPG sales data (tonnes) has been provided by the LPG Association. 'Auto' and 'Forklift' sales represent transport uses of LPG. All other sales represent stationary energy uses of LPG. Sales have been divided between territorial authorities on a per capita basis. The breakdown into sectors (Residential, Commercial, and Industrial) is based on NZ average consumption per sector as per MfE data.
Natural Gas Consumption	Natural gas consumption data has been provided by FirstGas. Territorial Authorities supplied by gas from each Point of Connection (POC) have been confirmed by FirstGas. Natural gas consumption has been split into residential, commercial, and industrial consumption based on information provided by PowerCo and national statistics from MBIE. Some POCs supply gas to particular industrial users exclusively, these have been taken into account.
Oil and Gas Fugitive Emissions	Not Calculated: There are no gas or oil processing plants within the region.
Agricultural Emissions	
General	Territorial authority livestock numbers and fertiliser data taken from the Agricultural Census (StatsNZ). The last territorial authority census was in 2017. Regional agricultural data from StatsNZ (2021) has been used to estimate the change in livestock and fertiliser use since 2017. Territorial authority land-use data provided by HBRC covering horticulture land-use.
Solid Waste Emissions	
Waste in Landfill	Landfill waste volume and end location information has been provided by the respective council departments. Where information is not available, waste volumes have been estimated based on historical national data on a per capita basis. Emissions are allocated to territorial authorities based on where the waste was produced, even if the waste is disposed in landfill outside the territorial authority.
Wastewater Emissions	
Wastewater Volume and Treatment Systems	Information on treated wastewater, and treatment plants has been provided by the respective council departments. Where information is not available, reasonable assumptions have been made and the WaterNZ database has been consulted. The population connected to septic tank systems have been estimated by the respective council departments. Where the population covered by Wastewater treatment plants and septic tanks does not account for the entire population, the remaining population is assigned to septic tanks. Emissions are allocated to territorial authorities based on where the wastewater was produced, even if the wastewater is treated outside the territorial authority.
Industrial Emissions	
Industrial processes	It is assumed that there are no significant non-energy related emissions of greenhouse gasses from industrial processes in the Region (e.g. aluminium manufacture).
Industrial Product Use	National data covering industrial product use (e.g. fire extinguishers, refrigerants) has been provided by the MfE. Emissions have been allocated to territorial authorities on a per capita basis.

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Forestry Emissions	
Exotic Forestry Harvested	Harvested forestry, and forest cover information for each territorial authority has been derived from Landcare Research data. It has been assumed that only 70% of the tree is removed as roundwood and that the above ground tree makes up approximately 74% of the total carbon stored.
Exotic Forest	Exotic forest land area for each territorial authority has been provided by Landcare Research.
Emission Factors	
General	All emission factors have detailed source information in the calculation tables within which they are used. Where possible, the most up to date, NZ-specific EFs have been applied. AR5 Global Warming Potential (GWP) figures for greenhouse gases have been used accounting for climate change feedbacks.

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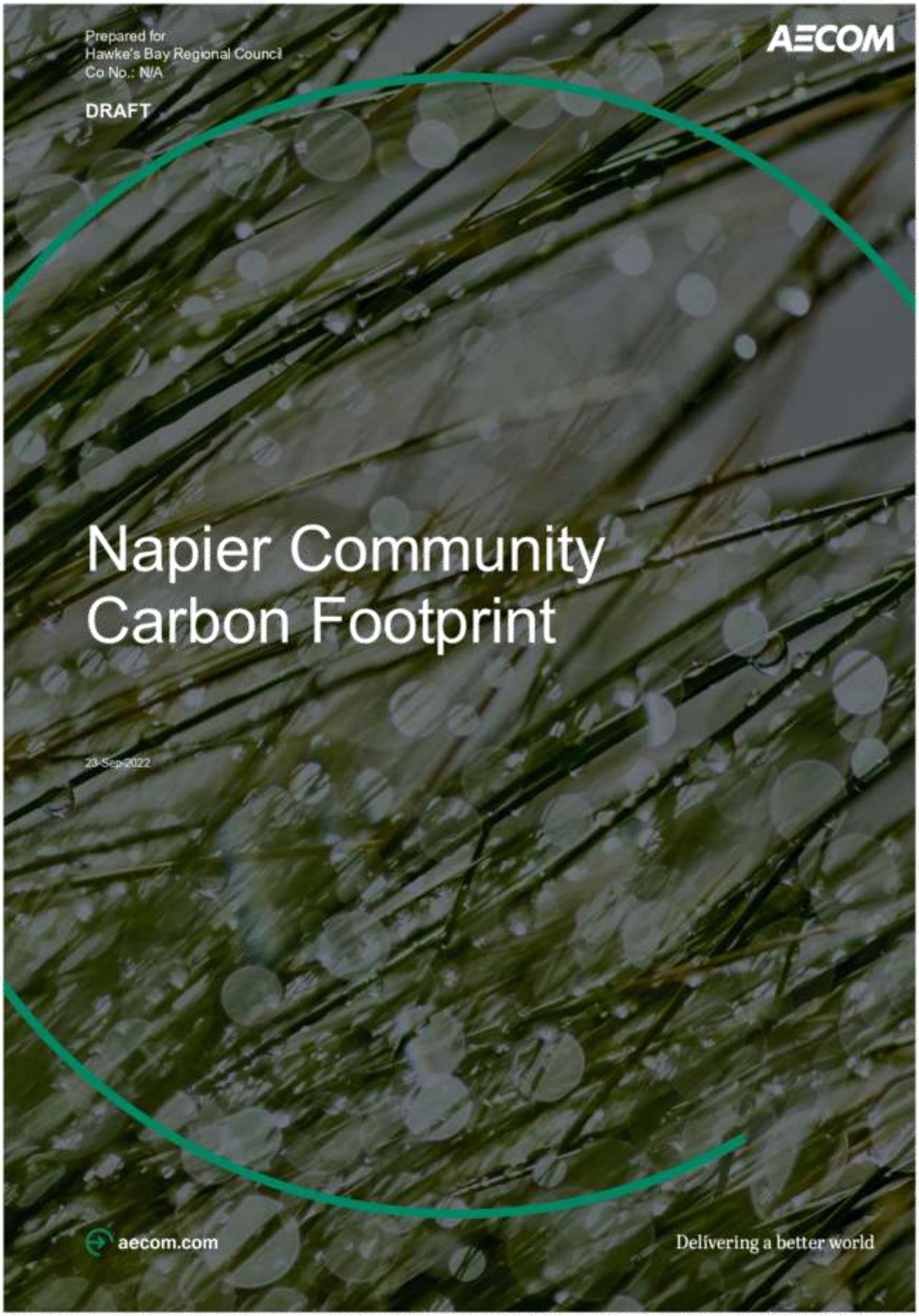
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Napier Community Carbon Footprint

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Prepared by

AECOM New Zealand Limited
Level 19, 171 Featherston Street, Wellington 6011, PO Box 27277, Wellington 6141, New Zealand
T +64 4 896 6000 F +64 4 896 6001 www.aecom.com

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Reviewed by Anthony Hume

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Executive Summary

Greenhouse Gas (GHG) emissions for Napier City Territorial Area (that is covered by the Napier City Council) have been measured using the Global Protocol for Community Scale Greenhouse Gas Emissions Inventory (GPC) methodology. This approach includes emissions from Stationary Energy, Transport, Waste, Industrial Processes and Product Use (IPPU), Agriculture and Forestry sectors. This document reports greenhouse gas emissions produced in or resulting from activity or consumption within the geographic boundaries of the Napier City Territorial Area for the 2020/21 financial reporting year and examines greenhouse gas emissions produced from 2018/19 to 2020/21.

The Napier City Territorial Area is referred to hereafter as Napier for ease. Greenhouse gas emissions are generally reported in this document in units of Carbon Dioxide Equivalents (CO_2e) and are referred to as 'emissions'.

Major findings of the project include:

2020/21 Emissions Footprint

- In the 2020/21 reporting year (1st July 2020 to 30th June 2021), **total gross emissions** in Napier were 457,725 tCO_2e.
- **Transport** (e.g. emissions from road and air travel) is the largest emitting sector in Napier, representing 52% of total gross emissions, with petrol and diesel consumption accounting for 46% of gross emissions.
- **Stationary Energy** (e.g. consumption of electricity and natural gas) is the second highest emitting sector in the region, producing 33% of total gross emissions.
- **Waste** is the third highest emitting sector in the city, producing 6% of total gross emissions.
- The **total net emissions** in Napier were 458,157 tCO_2e. The total net emissions include emissions from forestry which includes both carbon sequestration (carbon captured and stored in plants or soil by forests) and emissions from forest harvesting (e.g., the release of carbon from roots and organic matter following harvesting).

Changes in Emissions, 2018/19 to 2020/21

- Between 2018/19 and 2020/21, **total gross emissions** in Napier increased from 432,811 tCO_2e to 457,725 tCO_2e, an increase of 6% (24,914 tCO_2e).
- Over this time the population of the city increased by 3%, resulting in **per capita gross emissions** in Napier increasing by 3% between 2018/19 and 2020/21, from 6.7 to 6.9 tCO_2e per person per year.
- Emissions from **Stationary Energy** increased by 19% between 2018/19 and 2020/21 (24,274 tCO_2e), driven by a 43% increase in electricity consumption emissions (20,163 tCO_2e). This increase in electricity consumption emissions was due to a 2% increase in energy consumption (kWh) and a 41% increase in the emissions intensity of the national electricity grid (tCO_2e/kWh).
- Emissions from **Agriculture** decreased by 8%, between 2018/19 and 2020/21 (1,878 tCO_2e), due to a reduction in livestock numbers, particularly of sheep and non-dairy cattle.
- Emissions from **Transport**, **Waste** and **IPPU** between 2018/19 and 2020/21 remained relatively stable.
- **Forestry** emissions decreased by 453 tCO_2e (51%) between 2018/19 and 2020/21. Exotic forest harvesting and exotic forest sequestration both decreased during this time.

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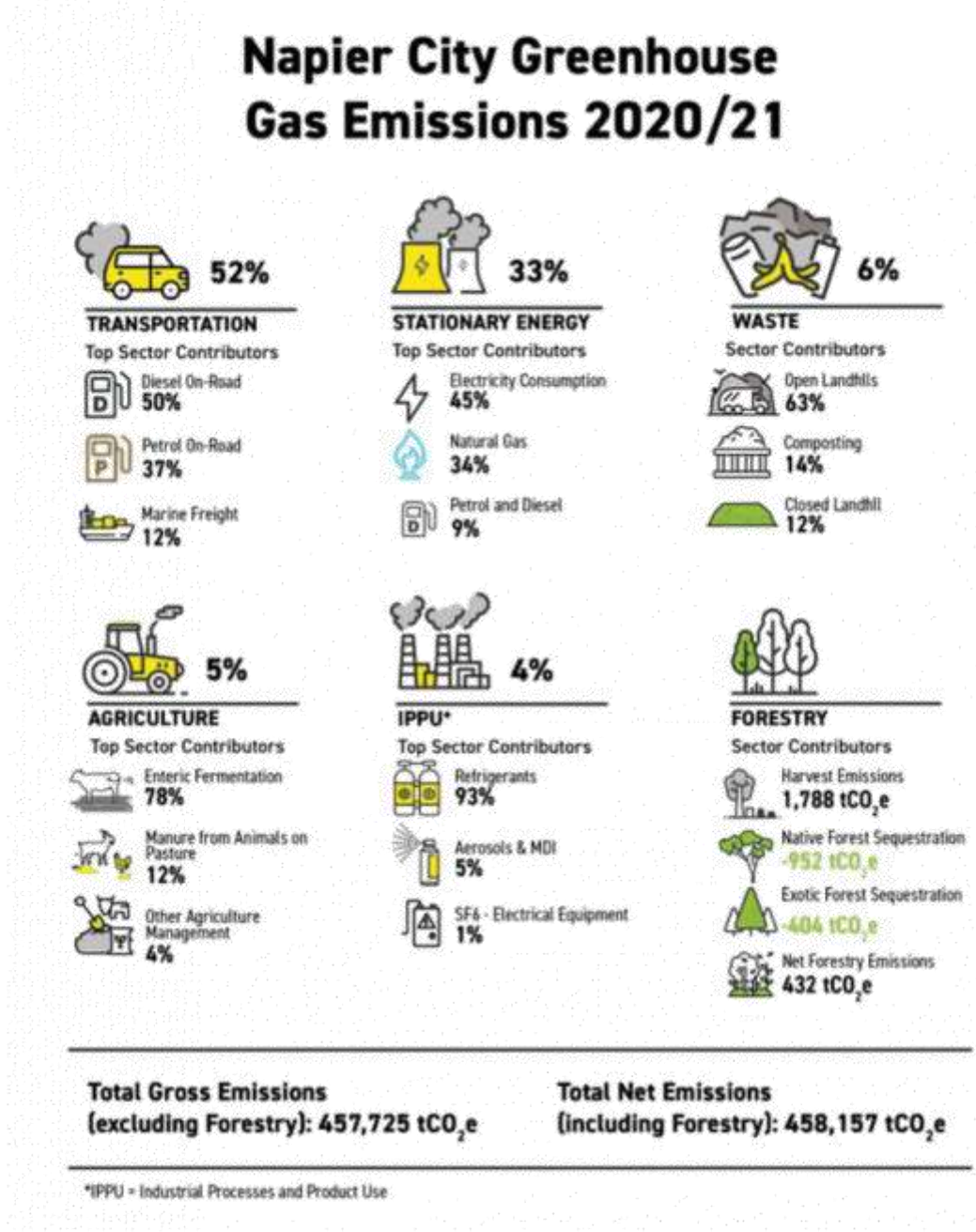
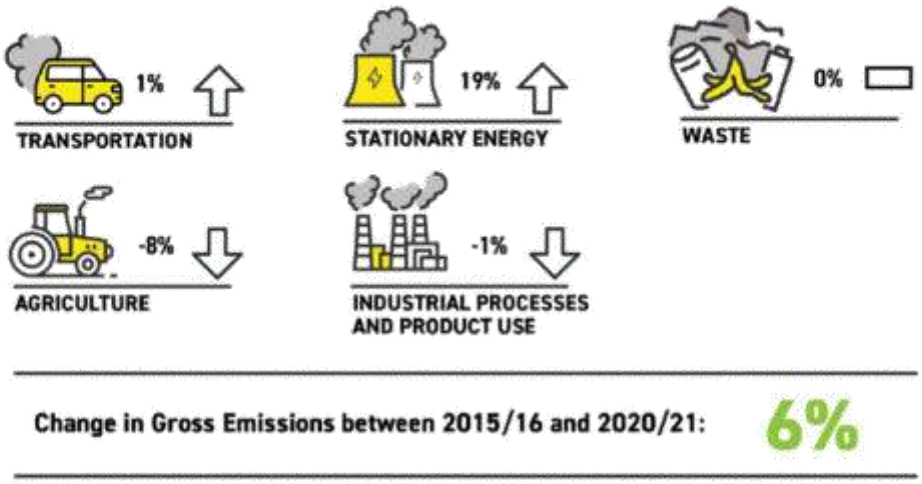
Figure 1: Napier 2020/21 Emissions Footprint



https://aecom.sharepoint.com/sites/HBRCCCFFY19-FY21/Shared Documents/General/4. Deliverables/220923 Final Reports/HBRC_CommunityCarbonFootprint_2022_Napier_220923_Final.docx
Revision 1 – 23-Sep-2022
Prepared for – Hawke's Bay Regional Council – Co No.: N/A

Figure 2: Change in Napier Emissions Footprint between 2015/16 and 2020/21



1.0 Introduction

AECOM New Zealand Limited (AECOM) was commissioned by the Hawke's Bay Regional Council to assist in the development of community-scale greenhouse gas (GHG) footprints for the Napier City Territorial Area for the 2018/19, 2019/20, and 2020/21 financial years. This is part of a wider study to develop community carbon footprints for each district within the Hawke's Bay region. Emissions are reported for the period from 1 July to 30 June for the respective years. The study boundary reported in the following pages incorporates the jurisdiction of the Napier City Council.

The Napier City Territorial Area is referred to hereafter as Napier for ease. Greenhouse gas emissions are generally reported in this document in units of Carbon Dioxide Equivalents (CO_2e) and are referred to as 'emissions'.

2.0 Approach and Limitations

The methodological approach used to calculate emissions follows the Global Protocol for Community Scale Greenhouse Gas Emissions Inventory v1.1 (GPC) published by the World Resources Institute (WRI) 2021. The GPC includes emissions from Stationary Energy, Transport, Waste, Industrial Processes and Product Use (IPPU), Agriculture, and Forestry activities within the city's boundary. The sector calculations for Agriculture, Forestry and Waste are based on Intergovernmental Panel on Climate Change (IPCC) workbooks and guidance for emissions measurement. The sector calculators also use methods consistent with GHG Protocol standards published by the WRI for emissions measurement when needed.

The same methodology has been used for other community scale GHG footprints around New Zealand, (e.g. Wellington, Auckland, Christchurch, Dunedin and the Waikato region) and internationally. The GPC methodology[1] represents international best practice for city and regional level GHG emissions reporting.

This emissions footprint assesses both direct and indirect emissions sources. Direct emissions are production-based and occur within the geographic area (Scope 1 in the GPC reporting framework). Indirect emissions are produced outside the geographic boundary (Scope 2 and 3) but are allocated to the location of consumption. An example of indirect emissions is those associated with the consumption of electricity, which is supplied by the national grid (Scope 2). All other indirect emissions such as cross-boundary travel (e.g. flights) and energy transportation and distribution losses fit into Scope 3.

All major assumptions made during data collection and analysis have been detailed within **Appendix A – Assumptions**. The following aspects are worth noting in reviewing the emissions footprint:

- Emissions are expressed on a carbon dioxide-equivalent basis (CO_2e) including climate change feedback using the 100-year Global Warming Potential (GWP) values[2]. Climate change feedbacks are the climate change impacts from GHGs that are increased as the climate changes. For example, once the Earth begins to warm, it triggers other processes on the surface and in the atmosphere. Current climate change feedback guidance is important to estimate the long-term impacts of GHGs.
- GPC reporting is predominately production-based (as opposed to consumption-based) but includes indirect emissions from energy consumption. Production-based emissions reporting is generally preferred by policy-makers due to robust established methodologies such as the GPC, which enables comparisons between different studies. Production-based approaches exclude globally produced emissions relating to consumption (e.g. embodied emissions relating to products produced elsewhere but consumed within the geographic area such as imported food products, cars, phones, clothes etc.).
- Total emissions are reported as both gross emissions (excluding Forestry) and net emissions (including Forestry).

[1] http://www.ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities
[2] https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf (Table 8.7)

- Emissions for individual main greenhouse gases for each emissions source are provided in the supplementary spreadsheet information supplied with this report.
- Where location specific data were not accessible, information was calculated based on national or regional level data.
- Transport emissions:
  - Transport emissions associated with air travel, rail, and marine fuel were calculated by working out the emissions relating to each journey arriving or departing the area based on data provided by the relevant operators. Emissions for these sources are then split equally between the destination and origin. Emissions relating to a particular point source (e.g. an airport or port) are allocated to the expected users of that source, not just the area that it is located in. For example, in the Hawke's Bay Region, it is expected that all territorial authorities will use the Port of Napier for imported and exported goods, emissions from this source have been allocated to all territorial authorities in the region based on population. It is understood that freight imports moving through the Port of Napier do not exclusively serve the Hawke's Bay Region, and freight exports do not exclusively originate from the Hawke's Bay Region, this should be considered when examining these emissions.
  - All other transport emissions are calculated using the fuel sold in the area (e.g. petrol, diesel, LPG).
- Solid waste emissions:
  - Solid waste emissions from landfill are measured using the IPCC First Order Decay method that covers landfill activity between 1950 and the present day.
  - Emissions are calculated for waste produced within the geographic boundary, even if they are transported outside the boundary to be entered into landfill. Landfill waste for Napier is disposed at Omarunui Landfill, jointly owned by the Hastings District Council and Napier City Council. This landfill is located within the Hastings geographic boundary.
- Wastewater emissions:
  - Emissions have been calculated based on the local data provided, following IPCC 2019 guidelines. Where data is missing, IPCC and Ministry for the Environment (MfE) figures have been used. Wastewater emissions from both wastewater treatment plants and individual septic tanks have been calculated.
  - Wastewater emissions include those released directly from wastewater treatment, flaring of captured gas and from discharge onto land/water.
- Industrial Processes and Product Use (IPPU) emissions:
  - IPPU emissions are estimated based on data provided in the New Zealand Greenhouse Gas Emissions 1990-2019 report (MfE 2021). Emissions are estimated on a per capita basis applying a national average per person.
- Forestry emissions:
  - This emissions footprint accounts for forest carbon stock changes from afforestation, reforestation, deforestation, and forest management (i.e. it applies land-use accounting conventions under the United Nations Framework Convention on Climate Change rather than the Kyoto Protocol). It treats emissions from harvesting and deforestation as instantaneous rather than accounting for the longer-term emission flows associated with harvested wood products.
  - The emissions footprint considers regenerating (growing) forest areas only. Capture of carbon from the atmosphere is negligible for mature forests that have reached a steady state.

Overall sector data and results for the emissions footprint have been provided to Napier City Council in calculation table spreadsheets. All assumptions made during data collection and analysis have been detailed within **Appendix A – Assumptions**.

It is important to consider the level of uncertainty associated with the results, particularly given the different datasets used. Depending on data availability, national, regional, and local datasets are used across the different calculators. At the national level, New Zealand's Greenhouse Gas Inventory shows that for 2018 (the most recent national level inventory) an estimate of gross emissions uncertainty was +/- 9%, whereas a net emissions uncertainty estimate was +/- 12%. These levels of uncertainty should be considered when interpreting the results of this community carbon footprint (MfE, 2020).

StatsNZ Regional Footprint

Due to differences in emission factors and methodology used between the StatsNZ Regional Footprints and this community carbon footprint (based on the GPC requirements and available data), caution should be taken when making comparison of reported emissions. One example of this is where this footprint used updated emission factors for methane and nitrous oxide following guidance from the IPCC and in line with other district and regional level GHG inventories in New Zealand. This difference is especially relevant for the Agriculture sector.

3.0 Community Carbon Footprint for 2020/21

The paragraphs, figures and tables below outline Napier's greenhouse gas emissions, referred to as 'emissions' in this assessment. This includes Napier's total emissions, emissions from each sector, and major emissions sources within each sector. The focus of emissions reporting is on **gross** emissions.

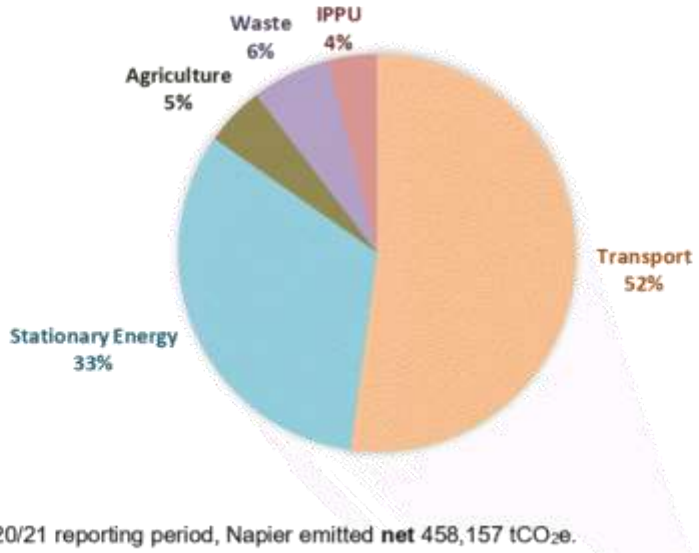
During the 2020/21 reporting period, Napier emitted **gross** 457,725 tCO_2e. Note that gross emissions do not account for Forestry. Transport and Stationary emissions are the largest contributors to total gross emissions for the city.

The population of Napier in 2020/21 was approximately 66,450 people, resulting in per capita gross emissions of 6.9 tCO_2e/person. Discussion of per capita emissions is limited to when it is useful for comparing emission figures against other territorial authorities. A breakdown of net emissions (i.e. including results from Forestry resources) is reported separately.

Table 1 Total net and gross emissions

Total emissions	tCO_2e
Total Net Emissions (including forestry)	458,157
Total Gross emissions (excluding forestry)	457,725

Figure 3: Napier City's total gross GHG emissions split by sector (tCO_2e).



During the 2020/21 reporting period, Napier emitted **net** 458,157 tCO_2e.

Net emissions differ from gross emissions because they include emissions related to forestry activity (harvesting emissions and sequestration) within an area. Forestry emissions are influenced by the cyclical nature of harvesting and planting regimes.

The community carbon footprint comprises emissions from six different sectors, summarised below:

3.1 Transport

The highest emitting sector in Napier, Transport, produced 238,626 tCO_2e in 2020/21 (52% of Napier's gross total emissions). Table 2 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emission source.

Table 2 Transport energy emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Diesel	120,362	26.3%	50.4%
Petrol	87,710	19.2%	36.8%
Marine Freight	28,890	6.3%	12.1%
Jet Kerosene	969	0.2%	0.4%
LPG	569	0.1%	0.2%
Aviation Gas	100	<0.1%	<0.1%
Rail	26	<0.1%	<0.1%
Total	**238,626**	**52%**	**100%**

Most of Transport emissions can be attributed to diesel and petrol, which produced 120,362 tCO_2e and 87,710 respectively (collectively 87% of the sector's emissions and 46% of total gross emissions). Diesel and petrol transport emissions are broken down into on-road and off-road use. On-road transport consists of all standard transportation vehicles used on roads (including cars, trucks, buses, etc.). Off-road transport consists of all fuel used for the movement of machinery and vehicles off roads (including agricultural tractors and vehicles, forklifts, etc.). On-road transport produced 184,805 tCO_2e (77% of Transport emissions) and Off-road transport produced 23,836 tCO_2e (10% of Transport emissions). An extra breakdown of on-road emissions by vehicle type and class is provided separate to this report.

The next largest emission source for Napier is marine freight, which contributed to 12% of the sectors emissions and 6% of total gross emissions (28,890 tCO_2e). Marine freight emissions are the result of freight movements to and from the Port of Napier. Emissions from this source have been divided between all territorial authorities in the Hawke's Bay region based on relative population sizes. It is understood that the imports and exports through this port are not exclusively related to activities in the Hawke's Bay region, however, to ensure that these emissions are reflected in community carbon footprints as per the GPC requirements this approach is appropriate.

The remaining Transport emissions are attributed to air travel (jet kerosene and aviation gas), rail freight emissions, and LPG use for transport (e.g. forklifts).

3.2 Stationary Energy

Producing 149,151 tCO_2e in 2020/21, Stationary Energy was Napier's second highest emitting sector (33% of total gross emissions). Table 3 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emission source.

Table 3 Stationary Energy emissions by emission source

Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Electricity Consumption	66,569	14.5%	44.6%
Natural Gas	51,095	11.2%	34.3%
Stationary Petrol & Diesel Use	13,426	2.9%	9.0%
Electricity Transmission & Distribution Losses	6,115	1.3%	4.1%
LPG	4,511	1.0%	3.0%
Natural Gas Transmission & Distribution Losses	4,130	0.9%	2.8%
Biofuel / Wood	2,004	0.4%	1.3%
Coal	1,259	0.3%	0.8%
Biogas	42	<0.1%	<0.1%
Total:	**149,151**	**33%**	**100%**

Electricity consumption was the cause of 45% of Stationary Energy emissions (66,569 tCO_2e), and 15% of Napier's total gross emissions (72,684 tCO_2e when including transmission and distribution losses related to the consumption). Natural gas consumption accounted for 34% of the Stationary Energy emissions (55,225 tCO_2e) when including transmission and distribution losses. The industrial sector is the primary consumer of electricity and natural gas in Napier.

Stationary petrol and diesel consumption generated 9% of Stationary Energy emissions (13,426 tCO_2e). Use of LPG, and the burning of coal, biofuels and biogas produced the remaining Stationary Energy emissions.

Stationary Energy demand can also be broken down by the sector in which it is consumed. Stationary Energy demand is reported for the following sectors: commercial; residential and industrial. However, emissions from petrol and diesel used for Stationary Energy are not able to be broken down by sector.

- Industrial Stationary Energy consumption accounts for 53% of Stationary Energy emissions (78,604 tCO_2e) and 17% of total gross emissions. Industrial Stationary Energy is energy used within all industrial settings (including agriculture, forestry and fishing, mining, food processing, textiles, chemicals, metals, mechanical/electrical equipment and building and construction activities).
- Residential Stationary Energy consumption accounts for 21% of Stationary Energy emissions (30,735 tCO_2e) and 7% of total gross emissions. Residential Stationary Energy is energy used in homes (e.g. for heating, lighting, and cooking).
- Commercial Stationary Energy consumption accounts for 18% of Stationary Energy emissions (26,334 tCO_2e) and 6% of total gross emissions. Commercial Stationary Energy is energy used in all non-residential and non-industrial settings (e.g. in retail, hospitality, education, and healthcare).
- The remaining 9% of Stationary Energy emissions (13,467 tCO_2e, 3% of gross emissions) were produced by diesel and petrol, and the burning of biogas, which were not allocated to the above categories. Stationary Energy uses of diesel and petrol include stationary generators and motors and for heating.

3.3 Waste

Waste originating in Napier (solid waste, wastewater and compost) produced 29,110 tCO_2e in 2020/21, which comprises 6% of Napier's total gross emissions. Table 4 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emission source.

Table 4 Waste emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Waste in open landfill sites	18,334	4.0%	63.0%
Composting	4,095	0.9%	14.1%
Waste in closed landfill sites	3,552	0.8%	12.2%
Wastewater treatment plants	2,689	0.6%	9.2%
Individual septic tanks	440	0.1%	1.5%
Total:	**29,110**	**6%**	**100%**

Solid waste produced the bulk of waste emissions (21,885 tCO_2e in 2020/21), making up 75% of total Waste emissions. Solid waste emissions include emissions from open landfills and closed landfills. Open landfill sites produced 18,334 tCO_2e and emissions from closed landfill sites produced 3,552 tCO_2e in 2020/21. Both open and closed landfills emit landfill (methane) gas from the breakdown of organic materials disposed of in the landfill for many years after waste enters the landfill. However, annual emissions from closed landfill sites will decrease over time as no new waste enters these sites. Waste from Napier is sent to Omarunui Landfill which is located within the Hastings geographic boundary but these emissions are still included in Napier's footprint.

Composting is the second largest source of emissions in Napier, accounting for 14% of total waste emissions (4,095 tCO_2e in 2020/21). Waste diverted from landfill for composting in the Hawke's Bay Region includes horticultural, animal waste products, green waste, bark and sawdust.

Wastewater treatment (treatment plants and individual septic tanks) produced 3,130 tCO_2e making up 11% of total Waste emissions. More than half of households in Napier are connected to wastewater treatments plants, which produced total emissions of 2,689 tCO_2e. Households connected to individual septic tanks produced 440 tCO_2e in wastewater emissions. Due to the production of methane, septic tanks have a higher emissions intensity compared to the wastewater treatments plants in Napier.

Wastewater treatment tends to be a relatively small emission source compared to solid waste as advanced treatment of wastewater produces low emissions. In contrast, solid waste generates methane gas over many years as organic material enters landfill and emissions depend on the efficiency and scale of landfill gas capture.

3.4 Agriculture

Agriculture emitted 22,462 tCO_2e in 2020/21 (5% of Napier's gross emissions). Table 5 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emissions source.

Agricultural emissions are the result of both livestock and crop farming. Enteric fermentation from livestock produced 78% of Napier's agricultural emissions (17,511 tCO_2e). Enteric fermentation GHG emissions are produced by methane (CH_4) released from the digestive process of ruminant animals (e.g. cattle and sheep). The second highest source of Agricultural emissions was produced from nitrous oxide (N_2O) released by unmanaged manure from grazing animals on pasture (2,604 tCO_2e or 12% of the agricultural sector's emissions).

Table 5 Agriculture emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Enteric fermentation	17,511	3.8%	78.0%
Manure from Grazing Animals	2,604	0.6%	11.6%
Other Agriculture Emissions	912	0.2%	4.1%
Atmospheric Deposition	709	0.2%	3.2%
Fertiliser used in Horticulture	454	0.1%	2.0%
Manure Management	222	<0.1%	1.0%
Agricultural Soils	49	<0.1%	0.2%
Total	**22,462**	**5%**	**100%**

Livestock were responsible for the majority of the Agriculture sector's GHG emissions (97%, or 21,920 tCO_2e) (Table 6). Sheep account for 57% of agricultural emissions and non-dairy cattle account for 40% of agricultural emissions in Napier.

Table 6 Agriculture emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Sheep	12,898	2.8%	57.4%
Non-dairy Cattle	8,951	2.0%	39.8%
Fertiliser for Horticulture	454	0.1%	2.0%
Fertiliser (other)	87	<0.1%	0.4%
Other Livestock	71	<0.1%	0.3%
Total	**2,462**	**5%**	**100%**

Fertilisers used for livestock and horticulture represent 2.4% of Agriculture emissions. An additional breakdown of emissions from fertiliser use in horticulture is included based on land-use information provided by HBRC. Fertiliser use in horticulture represented 2% of the sector emissions. The largest contributor to 'Fertiliser for Horticulture' in Napier was sweetcorn (249 tCO_2e, 55% of Fertiliser for Horticulture emissions). There is some potential for emissions double counting between the 'Fertiliser for Horticulture' and 'Fertiliser (other)' as these emissions have been calculated based on different datasets, where the 'Fertiliser (other)' category may also include some fertilisers used in horticulture. However, it is expected that the majority of the 'Fertiliser (other)' emissions are caused by fertiliser use for livestock land. Changes in soil carbon associated with horticulture have not been quantified due to absence of a defined appropriate method for assessing the carbon footprint associated with soil carbon change over time.

3.5 Industrial Processes and Product Use (IPPU)

IPPU in Napier produced 18,377 tCO_2e in 2020/21, contributing 4% to Napier's total gross emissions. This sector includes emissions associated with the consumption of GHGs for refrigerants, foam blowing, fire extinguishers, aerosols, metered dose inhalers and Sulphur Hexafluoride for electrical insulation and equipment production. IPPU emissions do not include energy use for industrial manufacturing, which is included in the relevant Stationary Energy sub-category (e.g. coal, electricity

and/or petrol and diesel). These emissions are based on nationally reported IPPU emissions and apportioned based on population due to the difficulty of allocating emissions to particular geographic locations. Addressing IPPU emissions is typically a national policy issue.

There are no known industrial processes (as defined in the GPC requirements) present in Napier (e.g. aluminium manufacture).

Table 7 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emission source. The most significant contributor to IPPU emissions is the use of refrigerants which produced 93% of IPPU emissions (17,086 tCO_2e).

Table 7 Industrial processes and product use emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Refrigerants and air conditioning	17,086	3.7%	93.0%
Aerosols	957	0.2%	5.2%
SF6 - Electrical Equipment	187	<0.1%	1.0%
Foam Blowing	81	<0.1%	0.4%
SF6 - Other	37	<0.1%	0.2%
Fire extinguishers	29	<0.1%	0.2%
Total	**18,377**	**4.0%**	**100.0%**

3.6 Forestry

Planting of native forest (e.g. mānuka and kānuka) and exotic forest (e.g. pine), sequesters (captures) carbon from the atmosphere while the trees are growing to maturity. Harvesting of forest emits emissions via the release of carbon from organic matters and soils following harvesting. When sequestration by forests exceeds emissions from harvesting in a particular year, the extra quantity of carbon sequestered by forest reduces total gross emissions for that year. Conversely when emissions from harvesting exceed the amount of carbon sequestered by native and exotic forests, then total gross emissions will increase.

Sequestration in 2020/21 was 1,356 tCO_2e (which was mostly from exotic forestry) while harvesting emissions were 1,788 tCO_2e. This meant that Forestry in Napier was a net positive source of emissions in 2020/21 (rather than a negative source of emissions, where sequestration exceeds harvesting). Total Forestry emissions in 2020/21 were 432 tCO_2e. It is noted that harvesting of exotic forest can be cyclical in nature where some years will have higher sequestration and some years will have higher harvesting emissions determined by age of forests, commercial operators, and the global market.

Table 8 Forestry emissions by emission source (including sequestration)

Sector / Emissions Source	tCO_2e
Total harvest emissions	1,788
Native forest sequestration	-404
Exotic forest sequestration	-952
Total	**432**

3.7 Total Gross Emissions by Greenhouse Gas

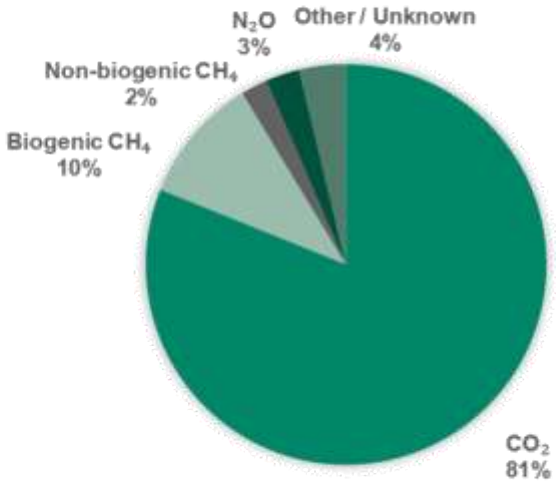
Each greenhouse gas has a different level of impact on climate change, this is accounted for when converting quantities of each gas into units of carbon dioxide equivalent (CO_2e).

Table 9: Napier's total gross emissions, by greenhouse gas

Greenhouse Gas	Tonnes	Tonnes of CO_2e
Carbon Dioxide (CO_2)	371,206	371,206
Biogenic Methane (CH_4)	1,379	46,881
Non-biogenic Methane (CH_4)	287	9,761
Nitrous Oxide (N_2O)	42	12,543
Other / Unknown Gas (in CO_2e)	17,334	17,334
Total	**390,248**	**457,725**

Figure 4 illustrates Napier's total gross emissions by greenhouse gas in units of carbon dioxide equivalents (CO_2e).

Figure 4: Napier's total gross emissions, by greenhouse gas (in tCO_2e)



By far the largest source of emissions in tonnes is carbon dioxide (CO_2) at 371,206 tonnes. Due to the greater global warming impact of methane, methane represents 0.4% of the total tonnage of GHG emissions from Napier but represents 12% of CO_2e. Nitrous oxide represents <0.1% of the total tonnage of GHG emissions from Napier but represents 3% of CO_2e.

3.8 Biogenic emissions

Biogenic carbon dioxide and methane emissions are stated in Table 10 and Table 11, respectively.

Biogenic CO_2 emissions are those that result from the combustion of biomass materials that store and sequester CO_2, including materials used to make biofuels (e.g. trees, crops, vegetable oils, or animal fats). Biogenic CO_2 emissions from plants and animals are excluded from gross and net emissions as they are part of the natural carbon cycle.

Table 10: Biogenic CO_2 in Napier (Excluded from gross emissions)

Biogenic Carbon Dioxide (CO_2) (Excluded from gross emissions)		
Biofuel	65,637	t CO_2
Landfill Gas	6,455	t CO_2
Total Biogenic CO_2	**72,092**	**t CO_2**

Biogenic CH_4 emissions (e.g., produced by farmed cattle via enteric fermentation) are included in gross emissions due to their relatively large impact on global warming relative to biogenic CO_2. Biogenic methane represents 0.4% of the gross total tonnage of GHG emissions in Napier but represents 10% of total gross GHG emissions when expressed in CO_2e. This is caused by the higher global warming impact of methane per tonne, compared to carbon dioxide. The total tonnage of each GHG and the contribution of each GHG to total gross emissions when expressed in CO_2e is shown in Table 9.

The importance of biogenic CH_4 is highlighted in NZ's Climate Change Response (Zero Carbon) Amendment Act. The Act includes specific targets to reduce biogenic CH_4 by between 24% and 47% below 2017 levels by 2050, and by 10% below 2017 levels by 2030. More information on the Act is available here: https://www.mfe.govt.nz/climate-change/zero-carbon-amendment-act.

Table 11: Biogenic Methane in Napier (Included in gross emissions)

Biogenic Methane (CH_4) (Included in gross emissions)		
Landfill Gas	644	t CH4
Enteric fermentation	515	t CH4
Wastewater Treatment	91	t CH4
Composting (Green Waste)	70	t CH4
Biofuel	53	t CH4
Manure Management	7	t CH4
Total Biogenic CH_4	**1,379**	**t CH4**

3.9 Territorial Authorities in the Hawke's Bay Region

The Hawke's Bay regional area contains several territorial authorities. Hastings District, Napier City, Central Hawkes Bay District, and Wairoa District are all exclusively within the boundaries of the Hawke's Bay region. Additionally, areas of Taupō District and Rangitīkei District are also part of the Hawke's Bay region. We estimate that 0.1% of Taupō's population and 12% of Taupō's area, and 0.3% of Rangitīkei's population and 14% of Rangitīkei's area are within the Hawke's Bay region.

Figure 5 shows the Hawke's Bay's total gross emissions divided by territorial authority. Figure 6 shows total gross emissions for the territorial authorities in the Hawke's Bay Region, split by sector. Both figures only include the emissions produced within the Hawke's Bay region for Taupō and Rangitīkei.

Hastings is the highest emitting territorial authority in the region, representing 43% of the Hawke's Bay's total gross emissions. Hastings' emissions inventory is predominantly agriculture-related emissions with the next largest emitting territorial authorities; Central Hawke's Bay and Wairoa, also containing significant agricultural emissions. Of the four territorial authorities entirely within the Hawke's Bay region, Napier has the lowest total gross emissions, with emissions mostly from Transport and Stationary Energy. The areas of Taupō and Rangitīkei contribute to 2% of the Hawke's Bay region's total gross emissions, almost entirely from Agriculture.

Figure 5 Hawke's Bay's total gross emissions divided by territorial authority (tCO_2e). *Taupō and Rangitīkei totals only include emissions produced in the Hawke's Bay region.

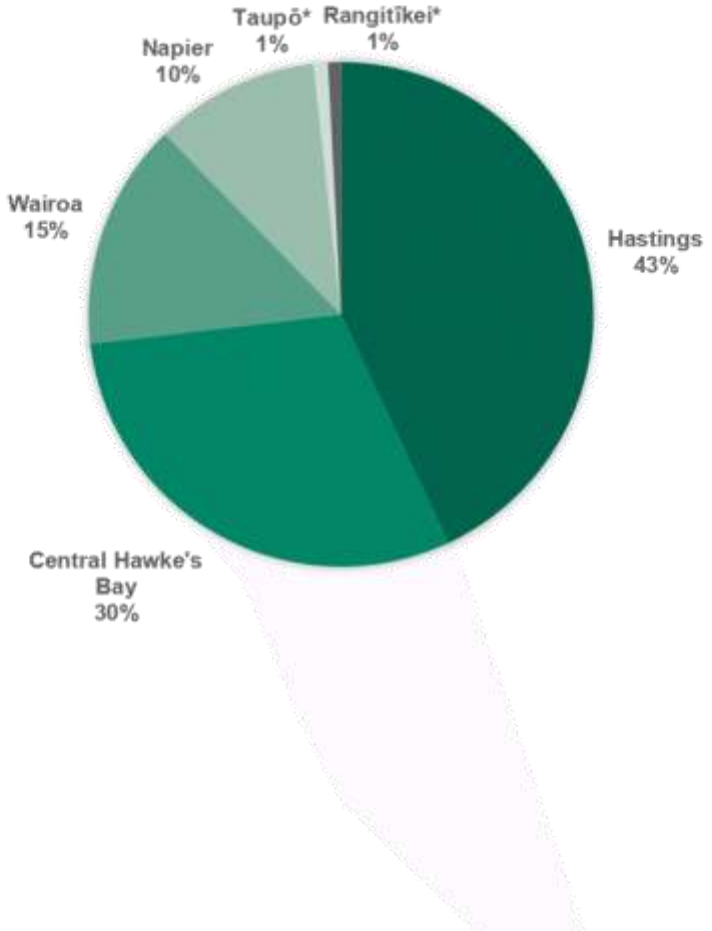
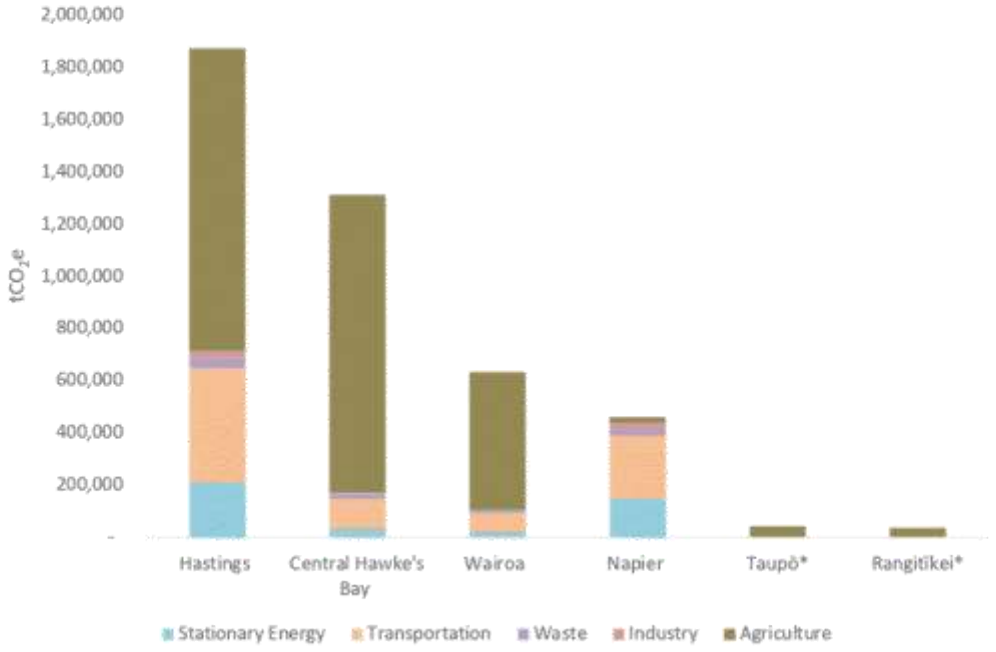


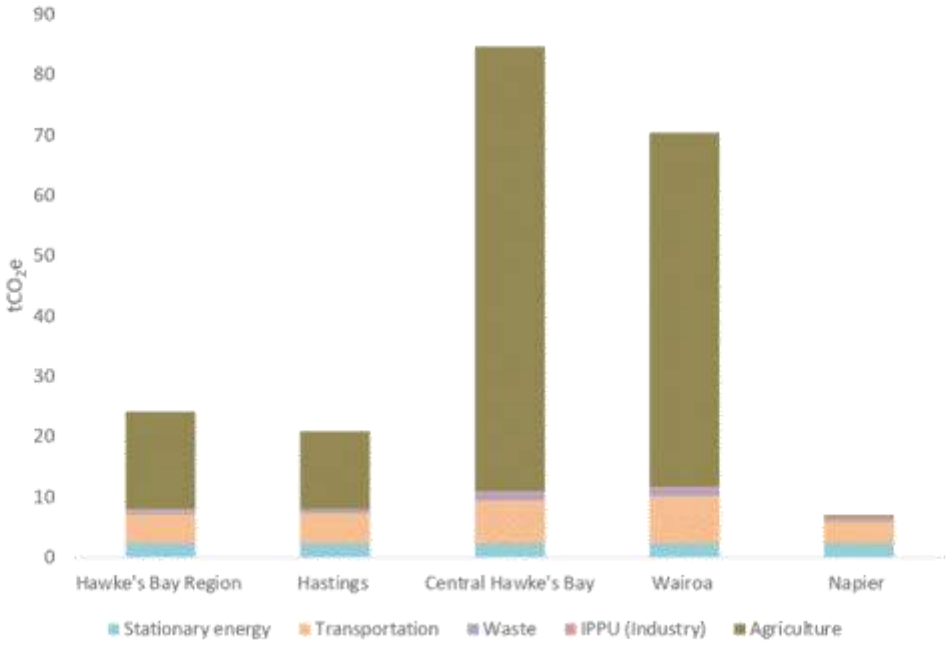
Figure 6 Total gross emissions by territorial authority in the Hawke's Bay region (tCO_2e). *Taupō and Rangitīkei totals only include emissions produced in the Hawke's Bay region.



When comparing emissions inventories from different areas, a per capita figure can be useful because it provides a common reference point to understand the difference in emissions. Figure 7 shows emissions per capita for the region and territorial authorities within the region. Taupō and Rangitīkei are excluded from this figure due to the tiny population and large agriculture within the small area in the Hawke's Bay creating very large per capita emissions (this is not the case for the entire Taupō or Rangitīkei district).

The Hawke's Bay region has a 24.1 tCO_2e/per capita figure for total gross emissions which is higher than the national value of 15.7 tCO_2e/per capita. Napier has the lowest per capita total emissions at 6.9 tCO_2e/per capita. Central Hawke's Bay and Wairoa have the largest per capita total gross emissions at 84.6 tCO_2e/per capita and 70.3 tCO_2e/per capita respectively, both due to high Agriculture emissions in the district. Hastings has the third highest per capita emissions at 20.9 tCO_2e/per capita, similar to that of the region. Notably, Napier's per capita emissions for Transport, Stationary Energy and Waste are the lowest of the four districts entirely within the Hawke's Bay region.

Figure 7 Total gross emissions per capita for the region and territorial authorities within the region (tCO_2e). *Taupō and Rangitīkei areas not included



4.0 Emissions change from 2018/19 to 2020/21

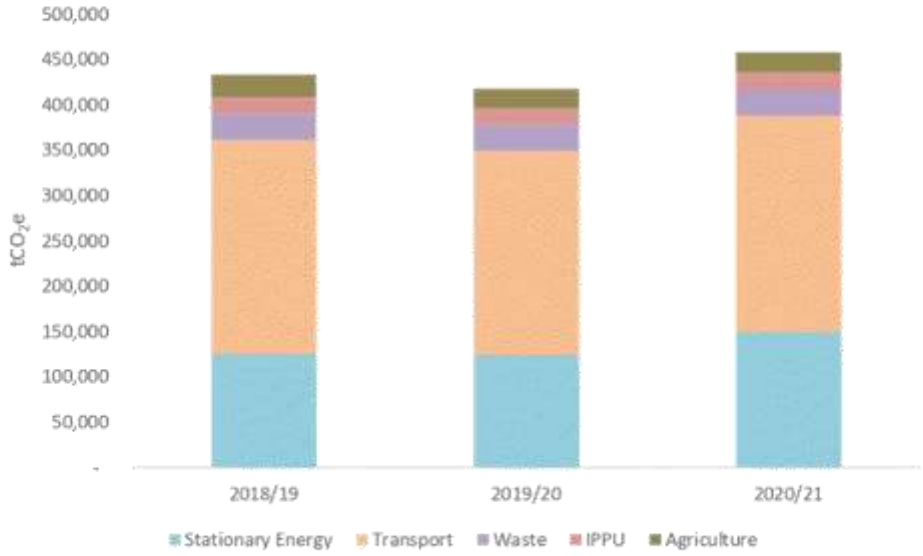
Alongside calculating Napier's emissions footprint for 2020/21, we have calculated Napier's emissions footprint for 2018/19 and 2019/20. This section displays the results of the 2018/19, 2019/20, and 2020/21 emissions footprints with a focus on gross emissions and documents the change in emissions from 2018/19 to 2020/21.

An analysis of the impact of the COVID-19 pandemic on Napier's emissions is found in Section 6.0. This section is cautious in examining the interpretation of changes, due to the footprint only assessing one financial year (2018/19) prior to the COVID-19 pandemic disruptions.

Table 12 Change in Napier's Total Gross and Net emissions from 2015/16 to 2020/21

	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Total Net Emissions (including forestry)	433,696	418,384	458,157	6%
Total Gross Emissions (excluding forestry)	432,811	417,678	457,725	6%

Figure 8 Change in Napier's total gross emissions from 2018/19 to 2020/21

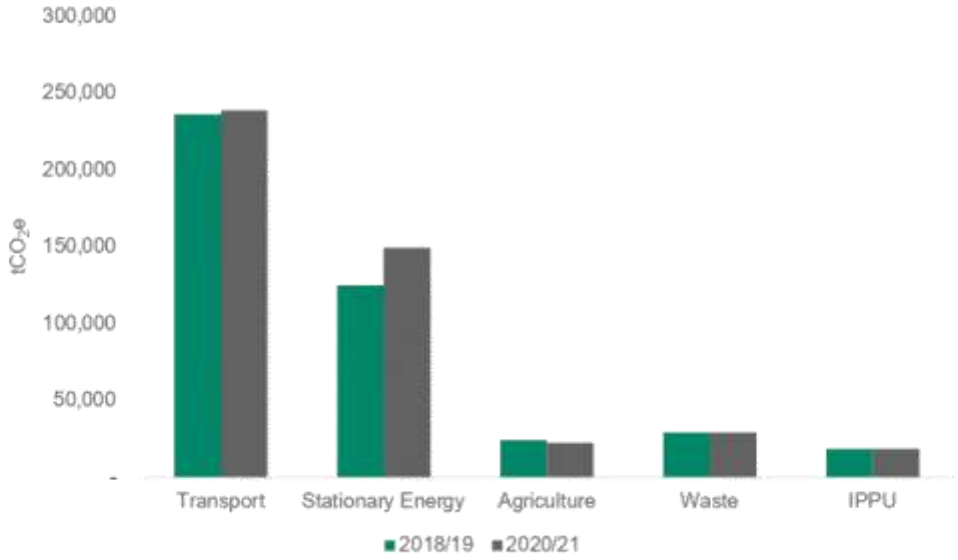


Annual total gross emissions increased by 6% from 432,811 tCO_2e in 2018/19 to 457,725 tCO_2e in 2020/21. Annual total net emissions in Napier increased by 6% from 433,696 in 2018/19 to 458,157 tCO_2e. The increase in both total gross and total net emissions was driven by an increase in Stationary Energy primarily related to the increase in the emissions intensity of the national electricity grid (tCO_2e/kWh).

The population of Napier grew by 3% between 2018/19 and 2020/21. This resulted in a 3% increase in per capita emissions between 2018/19 and 2020/21, from 6.7 to 6.9 tCO_2e per person per year. A discussion of the decoupling of gross emissions from population growth and GDP is found in Section 5.0.

The sections below outline the change in emissions between 2018/19 and 2020/21 for each sector and emissions source, highlighting the changes that have had the largest impact on total gross emissions.

Figure 9 Emissions for each sector of Napier's gross emissions footprint for 2018/19 and 2020/21



4.1 Transport

Table 13 Change in Napier's Transport emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Diesel	109,832	107,575	120,362	10%
Petrol	87,790	82,157	87,710	-0.1%
Marine Freight	33,786	33,576	28,890	-14%
Rail	2,599	42	26	-99%
Jet Kerosene	1,423	1,220	969	-32%
LPG	544	547	569	5%
Aviation Gas	82	97	100	22%
Total:	**236,054**	**225,213**	**238,626**	**1%**

Transport emissions increased by 1% between 2018/19 and 2020/21 (2,572 tCO_2e). This was driven by a 5% increase in on-road fuel emissions (8,462 tCO_2e).

It is noted that the impact of the COVID-19 pandemic can be seen in Transport emissions where emissions decreased by 5% between 2018/19 and 2019/20 due to reductions in road, marine freight, air transport fuel use. Aviation emissions continued to reduce in the 2020/21 reporting year, reflective of ongoing COVID-19 impacts to the industry.

4.2 Stationary Energy

Table 14 Change in Napier's Stationary Energy emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Natural Gas	49,575	47,629	51,095	3%
Electricity Consumption	46,407	47,322	66,569	43%
Stationary Petrol & Diesel Use	12,307	12,027	13,426	9%
LPG	4,308	4,337	4,511	5%
Electricity Transmission and Distribution Losses	4,052	4,148	6,115	51%
Natural Gas Transmission and Distribution Losses	4,007	3,850	4,130	3%
Coal	2,164	2,367	1,259	-42%
Biofuel / Wood	2,016	2,009	2,004	-1%
Biogas (landfill)	40	41	42	4%
Total:	**124,877**	**123,729**	**149,151**	**19%**

Emissions from Stationary Energy increased by 19% between 2018/19 and 2020/21 (24,274 tCO_2e). This was driven by a 43% increase in electricity consumption emissions (20,163 tCO_2e). The increase in electricity consumption emissions was due to a 2% increase in energy consumption (kWh) and a 41% increase in the emissions intensity of the national electricity grid (tCO_2e/kWh). The emissions intensity of the national grid has increased in recent years due to the increased use of fossil fuels during years with low hydro electricity generation. Emissions from industrial energy use is the largest driver in the increase in stationary emissions (9,875 tCO_2e).

4.3 Waste

Table 15 Change in Napier's Waste emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Open Landfill	17,679	17,941	18,334	4%
Composting	4,095	4,095	4,095	*NA*
Closed Landfill	3,943	3,741	3,552	-10%
Wastewater treatment plants	2,856	2,354	2,689	-6%
Individual septic tanks	429	435	440	3%
Total	**29,001**	**28,566**	**29,110**	**0.4%**

Total Waste emissions remained relatively unchanged between 2018/19 and 2020/21.

Total solid waste in landfill emissions changed by just 0.4% (264 tCO_2e). Emissions from waste in open landfills increased as the volume of waste entering the landfill increased up until 2020, and waste recently deposited in landfill reaches peak emissions per year (this is after approximately two years in landfill). Emissions from closed landfills decreased due to no extra waste being added, the existing waste in landfill releases fewer emissions over time. Due to data only being available for one singular year, no change in composting emissions is recorded.

Total wastewater emissions decreased by 5% (155 tCO_2e), this is due to a slight decrease in emissions from centralised wastewater treatment (167 tCO_2e).

4.4 Agriculture

Table 16 Change in Napier's Agriculture emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Enteric Fermentation	18,978	16,905	17,511	-8%
Manure from Grazing Animals	2,830	2,514	2,604	-8%
Other Agriculture Emissions	999	887	912	-9%
Atmospheric Deposition	772	686	709	-8%
Fertiliser used in Horticulture	454	454	454	0%
Manure Management	241	214	222	-8%
Agricultural Soils	64	56	49	-24%
Total	**24,339**	**21,716**	**22,462**	**-8%**

The Agriculture sector's emissions decreased by 8% between 2018/19 and 2020/21 (1,878 tCO_2e). This decrease is driven by a reduction in total livestock numbers, especially of sheep and non-dairy cattle (see Table 17).

Emissions related to sheep decreased by 1,348 tCO_2e due to a reduction in the number of sheep (2,459 sheep). Emissions related to non-dairy cattle decreased by 503 tCO_2e due to a reduction in the number of non-dairy cattle (254 cattle).

Table 17 Change in Napier livestock numbers from 2018/19 to 2020/21

	Number of animals (2018/19)	Number of animals (2020/21)	Change in number of animals (2015/16 to 2020/21)
Sheep	25,990	23,531	-2,459
Non-dairy Cattle	3,744	3,490	-254
Other livestock	87	86	-1
Total livestock	**29,821**	**27,107**	**-2,714**

Table 18 Change in Napier's livestock-associated Agriculture emissions from 2018/19 to 2020/21

	2018/19 emissions (tCO_2e)	2020/21 emissions (tCO_2e)	% Change in emissions (2015/16 to 2020/21)
Sheep	14,246	12,898	-9%
Non-dairy Cattle	9,454	8,951	-5%
Other livestock	70	71	1%
Total livestock	**23,770**	**21,920**	**-8%**

4.5 Industrial Processes and Product Use (IPPU)

Table 19 Change in Napier's IPPU emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Refrigerants and air conditioning	17,148	17,121	17,086	-0.4%
Aerosols	1,079	1,002	957	-11%
SF6 - Electrical Equipment	170	183	187	10%
Foam Blowing	75	81	81	7%
SF6 - Other	36.9	36.8	36.7	-1%
Fire extinguishers	30	30	29	-1%
Total	**18,540**	**18,453**	**18,377**	**-1%**

IPPU emissions decreased between 2018/19 and 2020/21, by 1% (162 tCO_2e). The decrease in IPPU emissions is mainly caused by a decrease in aerosols. Note that national level data is used for this sector and is portioned out using a population approach; exact emissions for the city are unknown.

4.6 Forestry

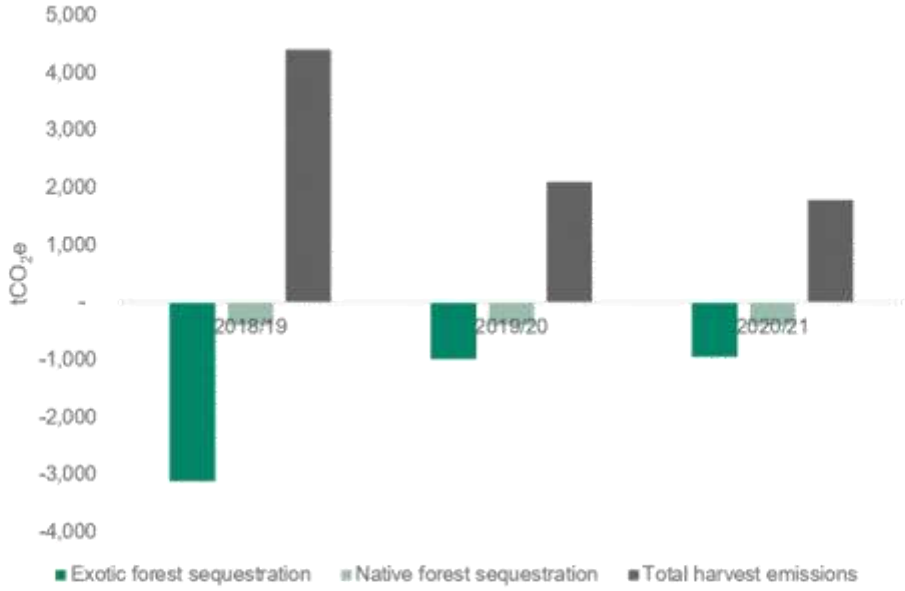
Table 20 Change in Napier's Forestry emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Total harvest emissions	4,401	2,099	1,788	-59%
Native forest sequestration	-404	-404	-404	0%
Exotic forest sequestration	-3,112	-990	-952	-69%
Total	**885**	**705**	**432**	**-51%**

Forestry emissions decreased by 453 tCO_2e (51%) between 2018/19 and 2020/21. This decrease was driven by a decrease in total harvest emissions (2,613 tCO_2e) as less exotic forest is harvested. During this time, sequestration also decreased due to a reduction in the extent of exotic forest.

Forestry emissions are influenced by the cyclical nature of harvesting and planting regimes where some years will have higher sequestration and some years will have higher harvesting emissions. This is dependent on age of forests and the demand for lumber and timber. This decrease in Napier harvesting emissions during this period is reflective a decrease in forestry harvesting across the region. Improved and updated data sources may impact the estimation of emissions from this source in the future. Sequestration by native forest remained relatively unchanged during this time.

Figure 10 Forestry sequestration and harvesting emissions from 2018/19 to 2020/21



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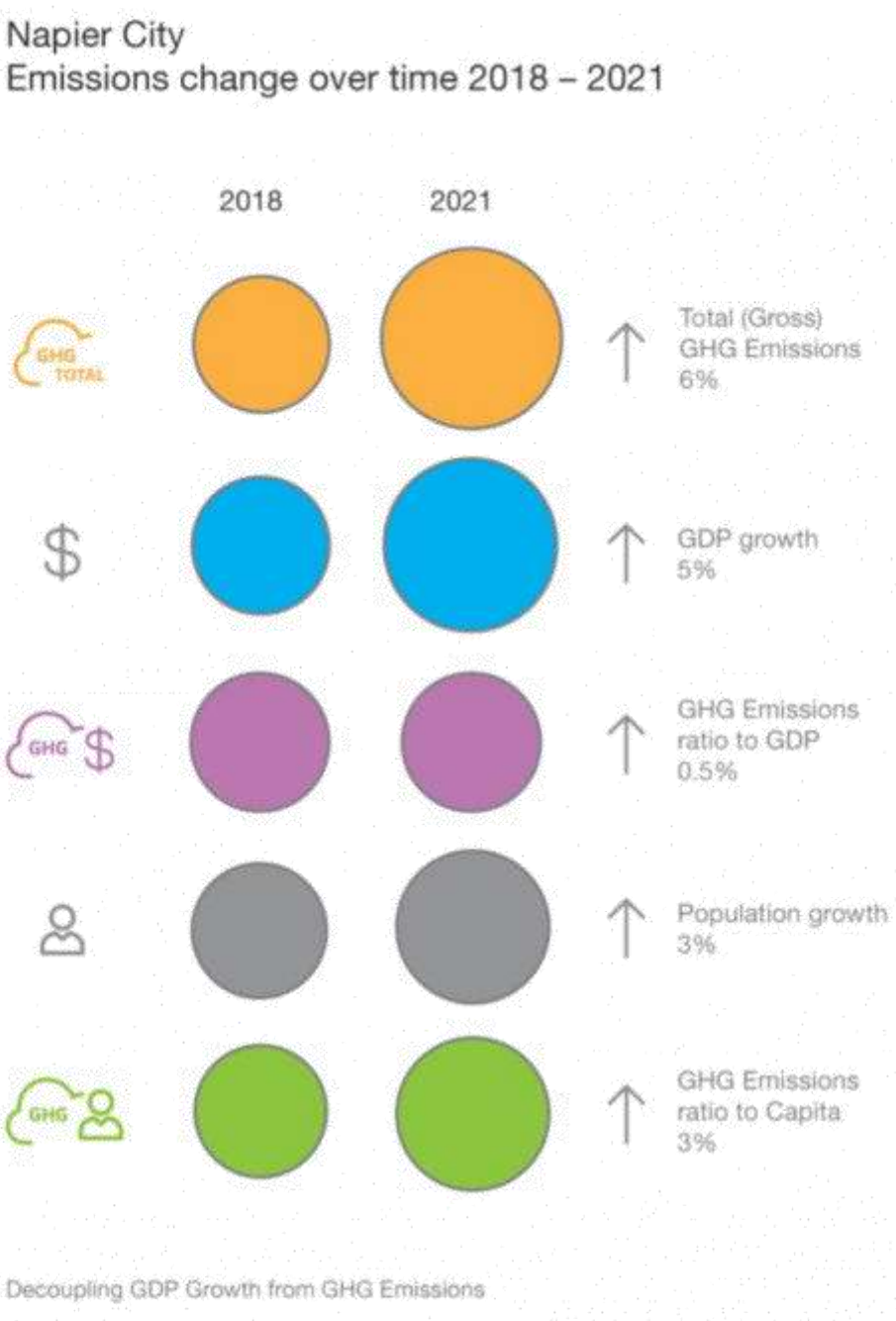
5.0 Decoupling of GHG emissions from population growth and GDP

Figure 11 shows the changes in gross emissions when compared to changes in other metrics of interest between 2018/19 and 2020/21. For example, total gross emissions have increased by 6%, whilst population in Napier has increased by 3%, resulting in a 3% increase in total gross emissions per capita. Similarly, Gross Domestic Product (GDP) in Napier has increased by 5%, resulting in a 0.5% increase in the GHG emissions ratio to GDP.

When emissions grow less rapidly than GDP (a measure of income) this process is known as decoupling. The term decoupling is an expression of the desire to mitigate emissions without harming economic wellbeing. A full discussion of decoupling of emissions is beyond the scope of this project. However, the changes in emissions and GDP illustrated in Figure 11 and discussed above, suggest at a high-level decoupling has occurred between 2018/19 and 2020/21.

The exact drivers for the decoupling of emissions from GDP are difficult to pinpoint. New policies, for restructuring the way to meet demand for energy, food, transportation and housing will all contribute. In this case, both direct local actions (e.g. landfill gas reductions) and indirect national trends (e.g. changes to emissions from electricity generation) will have contributed to trends noted.

Figure 11 Change in total gross emissions compared to other metrics of interest



6.0 Impact of the COVID-19 pandemic on GHG Emissions

COVID-19 impacted New Zealand and the entire world during 2020 and 2021; causing widespread government-imposed restrictions on businesses and individuals and huge shifts in behaviours and economic markets. Restrictions in New Zealand relating to COVID-19 began in mid-March 2020 with many personal and business restrictions continuing past the end of 2019/20 and throughout 2020/21.[3]

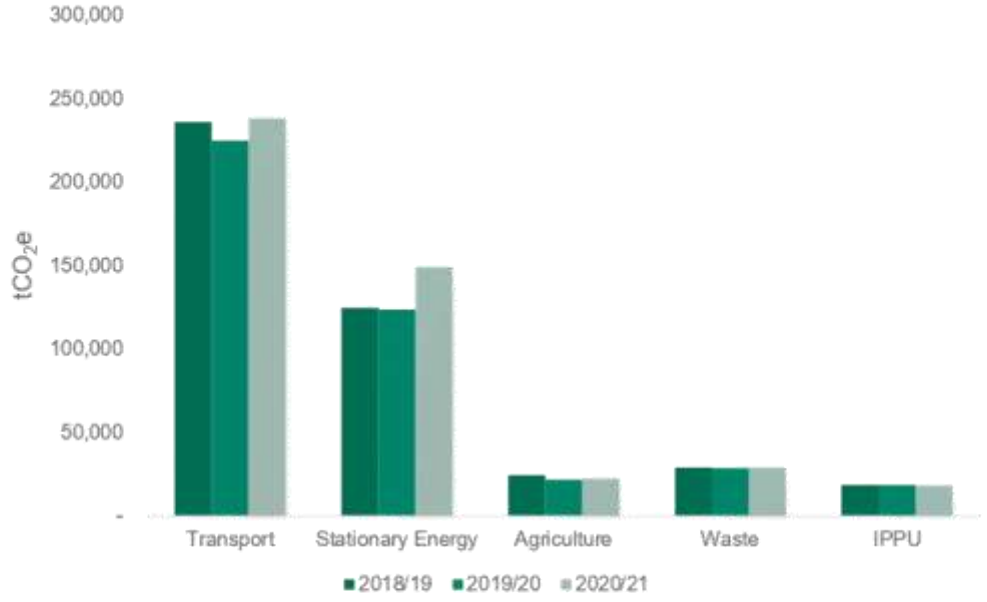
Globally, carbon dioxide emissions from fossil fuels (the largest contributor to greenhouse gas emissions) in 2020 decreased by 7% compared to 2019[4]. Emissions from the transportation sector account for the largest share of this decrease. Surface transport, e.g. car journeys, fell by approximately half at the peak of COVID-19 restrictions in April 2020 (when restrictions were at their maximum, particularly across Europe and the U.S. Globally, emissions recovered to near 2019 levels and are expected to continue to increase.

In New Zealand, national daily carbon dioxide emissions are estimated to have fallen by up to 41% during the level 4 lockdown in April 2020[5]. National gross emissions decreased by 3% from 2018/19 to 2019/20, which was largely driven by a decrease in fuel use in road transport due to COVID-19 pandemic restrictions, a decrease in fuel use in manufacturing industries and construction due to COVID-19 restrictions, and a decrease in fuel use from domestic aviation also due to COVID-19 restrictions.

Total gross emissions in Napier decreased by 15,132 tCO_2e (3%) between 2018/19 and 2019/20. Total gross emissions then increased by 40,047 tCO_2e (10%) between 2019/20 and 2020/21.

The impact on emissions in different sectors varied. Notably, Transport emissions reduced by 5% between 2018/19 and 2019/20, driven by reduced road and air transport fuel use. Despite changes in Stationary Energy, Agriculture, Waste, and IPPU emissions, these sectors are not judged to have been significantly affected by the COVID-19.

Figure 12 Napier emissions per sector for 2018/19, 2019/20, and 2020/21 (tCO_2e)



[3] https://covid19.govt.nz/alert-system/history-of-the-covid-19-alert-system/
[4] Pierre Friedlingstein et al. - Global Carbon Budget 2020 (2020)
[5] Corinne Le Quere et al. – Temporary Reduction in Daily Global CO_2 Emissions During the COVID-19 Forced Confinement

7.0 Closing Statement

Napier GHG emissions footprint provides information for decision-making and action by the council, Napier stakeholders, and the wider community. We encourage the council to use the results of this study to update current climate actions plans and set emission reduction targets.

The emissions footprint developed for Napier covers emissions produced in the Stationary Energy, Transport, Waste, IPPU, Agriculture, and Forestry sectors using the GPC reporting framework. Sector-level data allows Napier to target and work with the sectors that contribute the most emissions to the footprint.

Understanding of the extensive and long-lasting effects of climate change is improving all the time. It is recommended that this emissions footprint be updated regularly (every two or three years) to inform ongoing positive decision making to address climate change issues.

The accuracy of any emissions footprint is limited by the availability, quality, and applicability of data. Areas where data could be improved for future footprints include forestry (forest cover and harvesting), agriculture (especially livestock numbers), wastewater, and on and off-road transport fuel use.

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8.0 Limitations

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Appendix A

Assumptions and Data Sources

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Sector / Category	Assumption and Data Sources
General	
Geographical Boundary	LGNZ local council mapping boundaries have been applied. The emissions footprint for the Hawke's Bay Region covers the entirety of the Hawke's Bay Region (this excludes some of the Rangitikei and Taupō territorial authorities). Emissions footprints for each territorial authority covers the entirety of the territorial authority area.
Population	Population figures are provided by StatsNZ. Financial year populations have been used, these are based on the average population from the two calendar years (e.g. the average of 2018 and 2019 calendar year populations for FY19). The population of Taupo and Rangitikei Districts within the Hawke's Bay geographical boundary has been calculated.
Transport Emissions	
Petrol and Diesel:	Petrol and diesel sales data provided by Napier City Council for Napier, Central Hawkes Bay and Hastings. Combined sales data for Gisborne and Wairoa provided by Gisborne District Council and allocated to a region based on Waka Kotahi emissions data. Sales have been divided between territorial authorities based on the number of kilometres travelled by vehicles on roads (VKT) in each territorial authority. VKT data provided by Waka Kotahi. The division into transport and stationary energy end use (and within transport into on-road and off-road) has been calculated using fuel end use data provided by the Energy Efficiency and Conservation Authority (EECA) from the 2019 database. Biofuel sales information provided directly by the supplier.
Rail Diesel	Emissions from fuel use have been calculated and provided by Kiwi Rail. The following assumptions were made: - Net Weight is product weight only and excludes container tare (the weight of an empty container) - The Net Tonne-Kilometres (NTK) measurement has been used. NTK is the sum of the tonnes carried multiplied by the distance travelled. - National fuel consumption rates have been used to derive litres of fuel for distance. - Type of locomotive engine used, and jurisdiction topography, have not been incorporated in the calculations. The trans-boundary routes were determined, and the number of stops taken along the way derived. The total amount of litres of diesel consumed per route was then split between the departure district, arrival district and any district the freight stopped at along the way. If the freight travelled through but did not stop within a district, no emissions were allocated. This data is subject to commercial confidentiality.
Jet Kerosene (Scheduled Flights) Aviation Gas (General Aviation)	Calculated from information provided by Hawke's Bay Airport. Aviation fuel and jet kerosene fuel volumes were provided and emissions have been calculated using these volumes. Emissions have been divided between territorial authorities based the relative population of each territorial authority.

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Marine Freight	Shipping schedules have been provided by the Port of Napier. Emissions have been calculated based on ship weight and distance from the origin/destination to Napier. This figure does not include fishing vessels, or vessels with destination to be confirmed. Emissions from freight and international shipping are allocated equally between the origin and destination area emissions footprints. It is expected that imports and exports travelling through the Port of Napier service the entire Hawke's Bay Region. Emissions relating to freight and international shipping emissions have been divided between all Hawke's Bay territorial authorities based on population size.
Marine Fuel (Local)	Non-freight marine fuel use has not been included in this study. Fuel use by Port of Napier-controlled vessels has not been included due to a lack of available information. Most private marine vessels use fuel purchased at vehicle fuel stations. Petrol and diesel used in private marine vessels is included in off-road transportation.
LPG Consumption	North Island LPG sales data (tonnes) has been provided by the LPG Association. 'Auto' and 'Forklift' sales represent transport uses of LPG. Sales have been divided between territorial authorities on a per capita basis.
Stationary Energy Emissions	
Electricity Demand	Electricity demand has been calculated using grid exit point (GXP) data from the EMI website (www.emi.ea.govt.nz). Reconciled demand has been used as per EMI's confirmation. The territorial authorities serviced by each GXP have been confirmed by the respective electricity suppliers. The breakdown into sectors (Residential, Commercial, and Industrial) is based on NZ average consumption per sector as per Ministry for the Environment (MfE) data.
Electricity Generation	Electricity generation has been calculated using data from the EMI website (www.emi.ea.govt.nz). Small electricity generation has not been included in this data (e.g. domestic solar generation). This figure only includes electricity that is connected to the national electricity grid, direct users of electricity are not included.
Coal Consumption	National coal consumption data has been provided by MBIE. Regional industrial coal data has been provided by EECA. National residential and commercial coal consumption has been divided between territorial authorities on a per capita basis. Regional industrial coal consumption has been divided between territorial authorities on a per capita basis.
Coal Production and Fugitive Emissions	Not Calculated: There are no active coal mines within the region.
Biofuel Consumption	National biofuel consumption data has been provided by the Ministry for Business, Innovation and Employment (MBIE). Biofuel consumption has been divided between territorial authorities on a per capita basis. Biofuel emissions are broken down into Biogenic emissions (CO_2) and Non-Biogenic emissions (CH_4 and N_2O)

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LPG Consumption	North Island LPG sales data (tonnes) has been provided by the LPG Association. 'Auto' and 'Forklift' sales represent transport uses of LPG. All other sales represent stationary energy uses of LPG. Sales have been divided between territorial authorities on a per capita basis. The breakdown into sectors (Residential, Commercial, and Industrial) is based on NZ average consumption per sector as per MfE data.
Natural Gas Consumption	Natural gas consumption data has been provided by FirstGas. Territorial Authorities supplied by gas from each Point of Connection (POC) have been confirmed by FirstGas. Natural gas consumption has been split into residential, commercial, and industrial consumption based on information provided by PowerCo and national statistics from MBIE. Some POCs supply gas to particular industrial users exclusively, these have been taken into account.
Oil and Gas Fugitive Emissions	Not Calculated: There are no gas or oil processing plants within the region.
Agricultural Emissions	
General	Territorial authority livestock numbers and fertiliser data taken from the Agricultural Census (StatsNZ). The last territorial authority census was in 2017. Regional agricultural data from StatsNZ (2021) has been used to estimate the change in livestock and fertiliser use since 2017. Territorial authority land-use data provided by HBRC covering horticulture land-use.
Solid Waste Emissions	
Waste in Landfill	Landfill waste volume and end location information has been provided by the respective council departments. Where information is not available, waste volumes have been estimated based on historical national data on a per capita basis. Emissions are allocated to territorial authorities based on where the waste was produced, even if the waste is disposed in landfill outside the territorial authority.
Wastewater Emissions	
Wastewater Volume and Treatment Systems	Information on treated wastewater, and treatment plants has been provided by the respective council departments. Where information is not available, reasonable assumptions have been made and the WaterNZ database has been consulted. The population connected to septic tank systems have been estimated by the respective council departments. Where the population covered by Wastewater treatment plants and septic tanks does not account for the entire population, the remaining population is assigned to septic tanks. Emissions are allocated to territorial authorities based on where the wastewater was produced, even if the wastewater is treated outside the territorial authority.
Industrial Emissions	
Industrial processes	It is assumed that there are no significant non-energy related emissions of greenhouse gasses from industrial processes in the Region (e.g. aluminium manufacture).
Industrial Product Use	National data covering industrial product use (e.g. fire extinguishers, refrigerants) has been provided by the MfE. Emissions have been allocated to territorial authorities on a per capita basis.

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Forestry Emissions	
Exotic Forestry Harvested	Harvested forestry, and forest cover information for each territorial authority has been derived from Landcare Research data. It has been assumed that only 70% of the tree is removed as roundwood and that the above ground tree makes up approximately 74% of the total carbon stored.
Exotic Forest	Exotic forest land area for each territorial authority has been provided by Landcare Research.
Emission Factors	
General	All emission factors have detailed source information in the calculation tables within which they are used. Where possible, the most up to date, NZ-specific EFs have been applied. AR5 Global Warming Potential (GWP) figures for greenhouse gases have been used accounting for climate change feedbacks.

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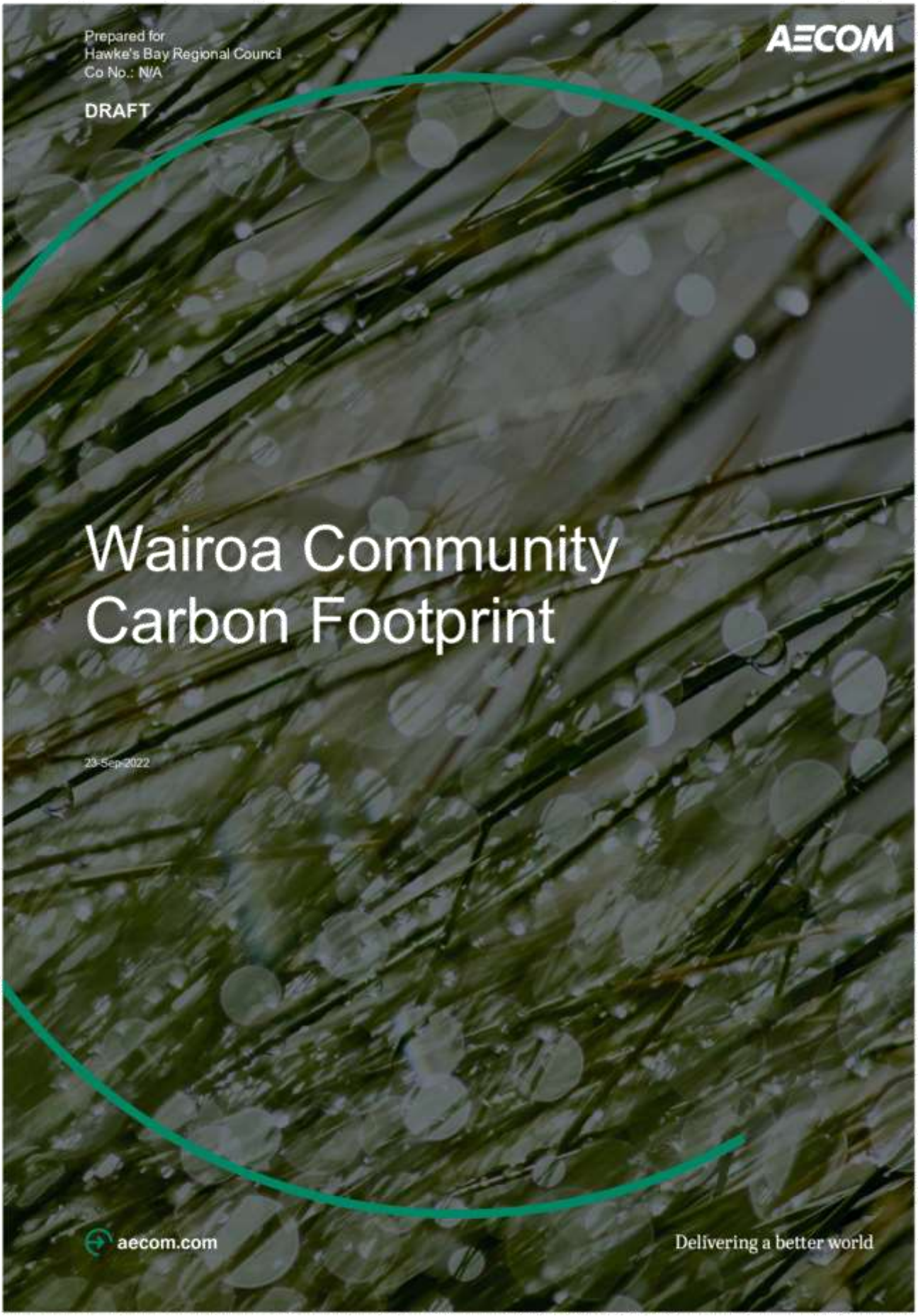
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Carbon Footprint
23-Sep-2022
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Wairoa Community Carbon Footprint

Client: Hawke's Bay Regional Council

Co No.: N/A

Prepared by

AECOM New Zealand Limited
Level 19, 171 Featherston Street, Wellington 6011, PO Box 27277, Wellington 6141, New Zealand
T +64 4 896 6000 F +64 4 896 6001 www.aecom.com

23-Sep-2022

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Quality Information

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Reviewed by Anthony Hume

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
1	23-Sept-2022	Draft Report v1	Anthony Hume Team Leader - Sustainability	

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Executive Summary

Greenhouse Gas (GHG) emissions for the Wairoa District Territorial Area (that is covered by the Wairoa District Council) have been measured using the Global Protocol for Community Scale Greenhouse Gas Emissions Inventory (GPC) methodology. This approach includes emissions from Stationary Energy, Transport, Waste, Industrial Processes and Product Use (IPPU), Agriculture and Forestry sectors. This document reports greenhouse gas emissions produced in or resulting from activity or consumption within the geographic boundaries of the Wairoa District Territorial Area for the 2020/21 financial reporting year and examines greenhouse gas emissions produced from 2018/19 to 2020/21.

The Wairoa District Territorial Area is referred to hereafter as Wairoa for ease. Greenhouse gas emissions are generally reported in this document in units of Carbon Dioxide Equivalents (CO_2e) and are referred to as 'emissions'.

Major findings of the project include:

2020/21 Emissions Footprint

- In the 2020/21 reporting year (1st July 2020 to 30th June 2021), **total gross emissions** in Wairoa were 632,319 1 tCO_2e.
- **Agriculture** (e.g. emissions from livestock and crops) is the largest source of emissions, accounting for 84% of Wairoa's total gross emissions, with enteric fermentation from livestock accounting for 66% of gross emissions.
- **Transport** (e.g. emissions from road and air travel) is the second largest emitting sector in Wairoa, representing 11% of total gross emissions, with petrol and diesel consumption accounting for 10% of gross emissions.
- **Stationary Energy** (e.g. consumption of electricity and natural gas) is the third highest emitting sector in the region, producing 3% of total gross emissions.
- Net **Forestry** emissions were -974,028 in 2020/21 as carbon sequestration (carbon captured and stored in plants or soil by forests) was higher than emissions from forest harvesting (e.g., the release of carbon from roots and organic matter following harvesting).
- The **total net emissions** in Wairoa were -341,709 tCO_2e. Total net emissions include emissions and sequestration from Forestry.

Changes in Emissions, 2018/19 to 2020/21

- Between 2018/19 and 2020/21, **total gross emissions** in Wairoa decreased from 672,467 tCO_2e to 632,319 tCO_2e, a decrease of 6% (40,148 tCO_2e).
- Over this time the population of the district increased by 3%, resulting in **per capita gross emissions** in Wairoa decreasing by 8% between 2018/19 and 2020/21, from 76.8 to 70.3 tCO_2e per person per year.
- Emissions from **Agriculture** decreased by 8%, between 2018/19 and 2020/21 (43,323 tCO_2e), due to a reduction in livestock numbers, particularly of sheep and non-dairy cattle.
- Emissions from **Stationary Energy** increased by 13% between 2018/19 and 2020/21 (2,450 tCO_2e), driven by a 45% increase in electricity consumption emissions (2,118 tCO_2e). This increase in electricity consumption emissions was due to a 3% increase in energy consumption (kWh) and a 41% increase in the emissions intensity of the national electricity grid (tCO_2e/kWh).
- **Transport** emissions increased by 1% between 2018/19 and 2020/21 (546 tCO_2e), driven by a 2% increase in on-road fuel emissions (946 tCO_2e). Marine freight and air travel emissions reduced during this period, likely due to the impact of COVID-19.
- Emissions from **Waste** increased by 2% between 2018/19 and 2020/21 (204 tCO_2e).
- Emissions from forest harvesting increased by 52% (499,306 tCO_2e) resulting in the net impact of **Forestry** changing from -1,408,899 tCO_2e to -947,028 tCO_2e.

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Figure 1: Wairoa 2020/21 Emissions Footprint

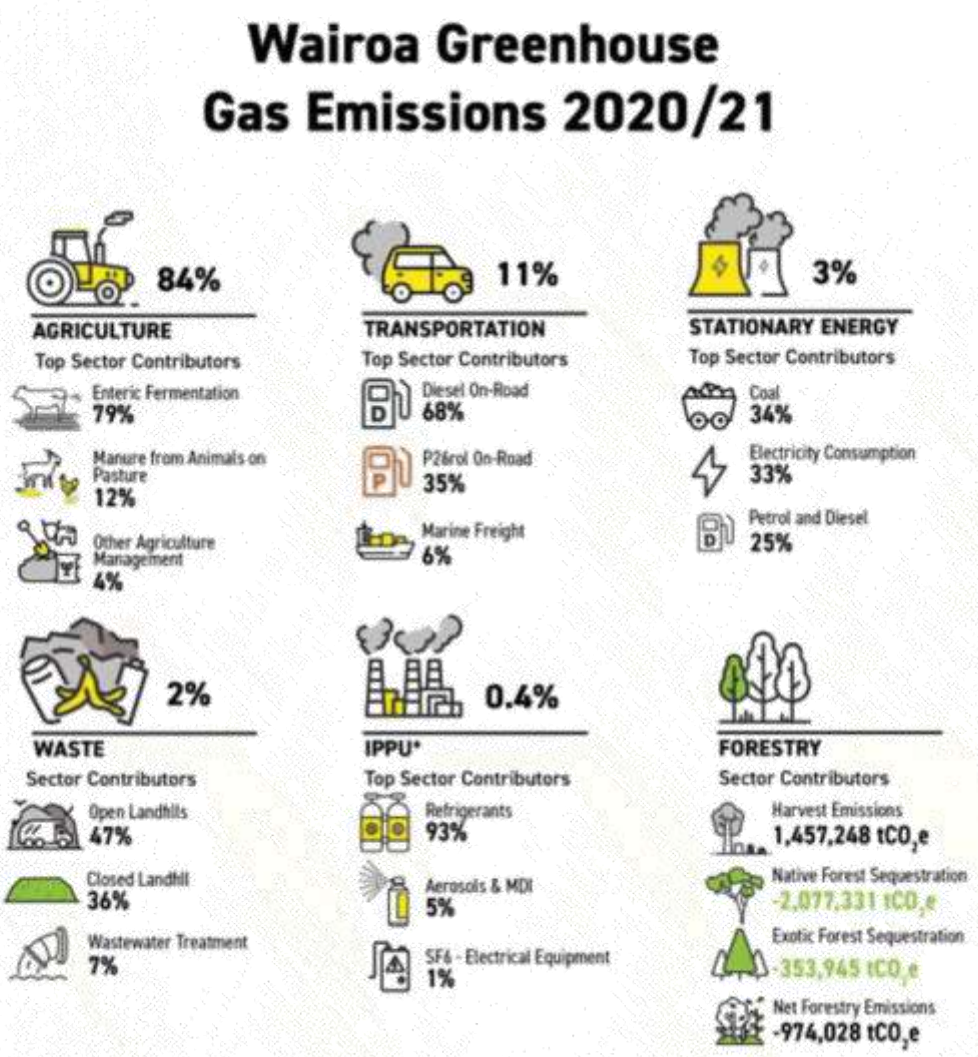

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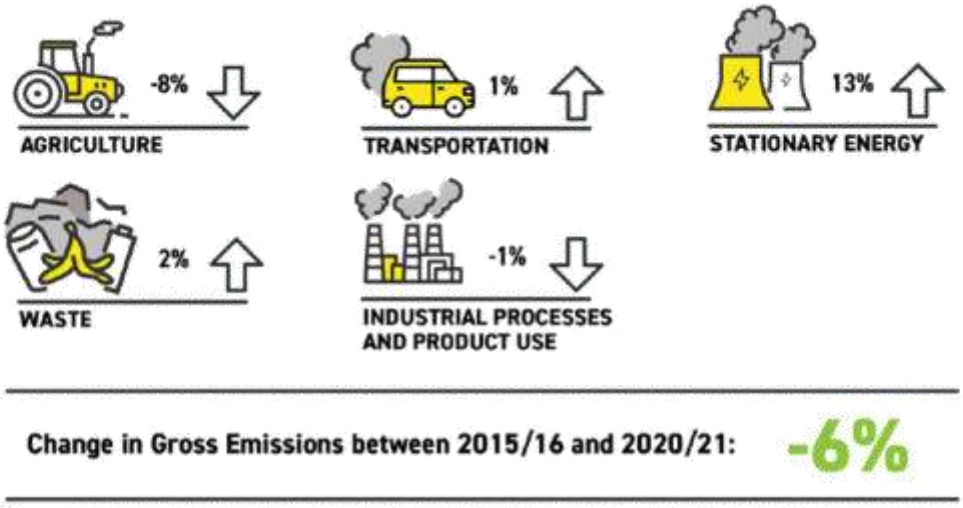
Figure 2: Change in Wairoa Emissions Footprint between 2015/16 and 2020/21



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1.0 Introduction

AECOM New Zealand Limited (AECOM) was commissioned by the Hawke's Bay Regional Council to assist in the development of community-scale greenhouse gas (GHG) footprints for the Wairoa District Territorial Area for the 2018/19, 2019/20, and 2020/21 financial years. This is part of a wider study to develop community carbon footprints for each district within the Hawke's Bay region. Emissions are reported for the period from 1 July to 30 June for the respective years. The study boundary reported in the following pages incorporates the jurisdiction of the Wairoa District Council.

The Wairoa District Territorial Area is referred to hereafter as Wairoa for ease. Greenhouse gas emissions are generally reported in this document in units of Carbon Dioxide Equivalents (CO_2e) and are referred to as 'emissions'.

2.0 Approach and Limitations

The methodological approach used to calculate emissions follows the Global Protocol for Community Scale Greenhouse Gas Emissions Inventory v1.1 (GPC) published by the World Resources Institute (WRI) 2021. The GPC includes emissions from Stationary Energy, Transport, Waste, Industrial Processes and Product Use (IPPU), Agriculture, and Forestry activities within the district's boundary. The sector calculations for Agriculture, Forestry and Waste are based on Intergovernmental Panel on Climate Change (IPCC) workbooks and guidance for emissions measurement. The sector calculators also use methods consistent with GHG Protocol standards published by the WRI for emissions measurement when needed.

The same methodology has been used for other community scale GHG footprints around New Zealand, (e.g. Wellington, Auckland, Christchurch, Dunedin and the Waikato region) and internationally. The GPC methodology[1] represents international best practice for city and regional level GHG emissions reporting.

This emissions footprint assesses both direct and indirect emissions sources. Direct emissions are production-based and occur within the geographic area (Scope 1 in the GPC reporting framework). Indirect emissions are produced outside the geographic boundary (Scope 2 and 3) but are allocated to the location of consumption. An example of indirect emissions is those associated with the consumption of electricity, which is supplied by the national grid (Scope 2). All other indirect emissions such as cross-boundary travel (e.g. flights) and energy transportation and distribution losses fit into Scope 3.

All major assumptions made during data collection and analysis have been detailed within **Appendix A – Assumptions**. The following aspects are worth noting in reviewing the emissions footprint:

- Emissions are expressed on a carbon dioxide-equivalent basis (CO_2e) including climate change feedback using the 100-year Global Warming Potential (GWP) values[2]. Climate change feedbacks are the climate change impacts from GHGs that are increased as the climate changes. For example, once the Earth begins to warm, it triggers other processes on the surface and in the atmosphere. Current climate change feedback guidance is important to estimate the long-term impacts of GHGs.
- GPC reporting is predominately production-based (as opposed to consumption-based) but includes indirect emissions from energy consumption. Production-based emissions reporting is generally preferred by policy-makers due to robust established methodologies such as the GPC, which enables comparisons between different studies. Production-based approaches exclude globally produced emissions relating to consumption (e.g. embodied emissions relating to products produced elsewhere but consumed within the geographic area such as imported food products, cars, phones, clothes etc.).
- Total emissions are reported as both gross emissions (excluding Forestry) and net emissions (including Forestry).

[1] http://www.ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities
[2] https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf (Table 8.7)

- Emissions for individual main greenhouse gases for each emissions source are provided in the supplementary spreadsheet information supplied with this report.
- Where location specific data were not accessible, information was calculated based on national or regional level data.
- Transport emissions:
  - Transport emissions associated with air travel, rail, and marine fuel were calculated by working out the emissions relating to each journey arriving or departing the area based on data provided by the relevant operators. Emissions for these sources are then split equally between the destination and origin. Emissions relating to a particular point source (e.g. an airport or port) are allocated to the expected users of that source, not just the area that it is located in. For example, in the Hawke's Bay Region, it is expected that all territorial authorities will use the Port of Napier for imported and exported goods, emissions from this source have been allocated to all territorial authorities in the region based on population. It is understood that freight imports moving through the Port of Napier do not exclusively serve the Hawke's Bay Region, and freight exports do not exclusively originate from the Hawke's Bay Region, this should be considered when examining these emissions.
  - All other transport emissions are calculated using the fuel sold in the area (e.g. petrol, diesel, LPG).
- Solid waste emissions:
  - Solid waste emissions from landfill are measured using the IPCC First Order Decay method that covers landfill activity between 1950 and the present day.
  - Emissions are calculated for waste produced within the geographic boundary, even if they are transported outside the boundary to be entered into landfill.
- Wastewater emissions:
  - Emissions have been calculated based on the local data provided, following IPCC 2019 guidelines. Where data is missing, IPCC and Ministry for the Environment (MfE) figures have been used. Wastewater emissions from both wastewater treatment plants and individual septic tanks have been calculated.
  - Wastewater emissions include those released directly from wastewater treatment, flaring of captured gas and from discharge onto land/water.
- Industrial Processes and Product Use (IPPU) emissions:
  - IPPU emissions are estimated based on data provided in the New Zealand Greenhouse Gas Emissions 1990-2019 report (MfE 2021). Emissions are estimated on a per capita basis applying a national average per person.
- Forestry emissions:
  - This emissions footprint accounts for forest carbon stock changes from afforestation, reforestation, deforestation, and forest management (i.e. it applies land-use accounting conventions under the United Nations Framework Convention on Climate Change rather than the Kyoto Protocol). It treats emissions from harvesting and deforestation as instantaneous rather than accounting for the longer-term emission flows associated with harvested wood products.
  - The emissions footprint considers regenerating (growing) forest areas only. Capture of carbon from the atmosphere is negligible for mature forests that have reached a steady state.

Overall sector data and results for the emissions footprint have been provided to Wairoa District Council in calculation table spreadsheets. All assumptions made during data collection and analysis have been detailed within **Appendix A – Assumptions**.

It is important to consider the level of uncertainty associated with the results, particularly given the different datasets used. Depending on data availability, national, regional, and local datasets are used across the different calculators. At the national level, New Zealand's Greenhouse Gas Inventory shows

that for 2018 (the most recent national level inventory) an estimate of gross emissions uncertainty was +/- 9%, whereas a net emissions uncertainty estimate was +/- 12%. These levels of uncertainty should be considered when interpreting the results of this community carbon footprint (MfE, 2020).

StatsNZ Regional Footprint

Due to differences in emission factors and methodology used between the StatsNZ Regional Footprints and this community carbon footprint (based on the GPC requirements and available data), caution should be taken when making comparison of reported emissions. One example of this is where this footprint used updated emission factors for methane and nitrous oxide following guidance from the IPCC and in line with other district and regional level GHG inventories in New Zealand. This difference is especially relevant for the Agriculture sector.

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3.0 Community Carbon Footprint for 2020/21

The paragraphs, figures and tables below outline Wairoa's greenhouse gas emissions, referred to as 'emissions' in this assessment. This includes Wairoa's total emissions, emissions from each sector, and major emissions sources within each sector. The focus of emissions reporting is on gross emissions.

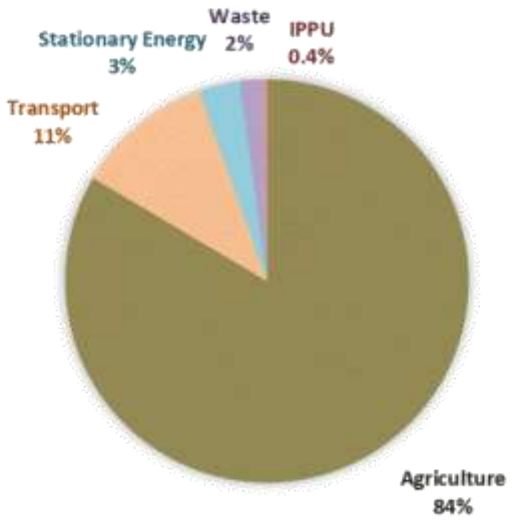
During the 2020/21 reporting period, Wairoa emitted **gross** 632,319 tCO_2e. Note that gross emissions do not account for Forestry. Agriculture and Transport emissions are the largest contributors to total gross emissions for the district.

The population of Wairoa in 2020/21 was approximately 8,995 people, resulting in per capita gross emissions of 70.3 tCO_2e/person. Discussion of per capita emissions is limited to when it is useful for comparing emission figures against other territorial authorities. A breakdown of net emissions (i.e. including results from Forestry resources) is reported separately.

Table 1 Total net and gross emissions

Total emissions	tCO_2e
Total Net Emissions (including forestry)	-341,709
Total Gross emissions (excluding forestry)	632,319

Figure 3: Wairoa District's total gross GHG emissions split by sector (tCO_2e).



During the 2020/21 reporting period, Wairoa emitted **net** -341,709 tCO_2e.

Net emissions differ from gross emissions because they include emissions related to forestry activity (harvesting emissions and sequestration) within an area. Forestry emissions are influenced by the cyclical nature of harvesting and planting regimes.

Carbon sequestered by forestry can be viewed as a liability/risk that needs careful consideration. For example, if plantations are not replanted or other land use change occurs to exotic forested areas, then net emissions may rise quickly. Equally, if native forest is not protected from removal, and removal does happen, then net emissions may rise.

The community carbon footprint comprises emissions from six different sectors, summarised below:

3.1 Agriculture

The highest emitting sector in Wairoa, Agriculture, emitted 527,999 tCO_2e in 2020/21 (Table 2). Agricultural emissions are the result of both livestock and crop farming. Enteric fermentation from livestock produced 79% of Wairoa agricultural emissions (418,083 tCO_2e). Enteric fermentation GHG emissions are produced by methane (CH_4) released from the digestive process of ruminant animals (e.g. cattle and sheep). The second highest source of agricultural emissions was produced from nitrous oxide (N_2O) released by unmanaged manure from grazing animals on pasture (61,099 tCO_2e or 11% of the agricultural sector's emissions).

Table 2 Agriculture emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Enteric fermentation	418,083	66.1%	79.2%
Manure from Grazing Animals	61,099	9.7%	11.6%
Other Agriculture Emissions	22,693	3.6%	4.3%
Atmospheric Deposition	16,878	2.7%	3.2%
Manure Management	6,274	1.0%	1.2%
Agricultural Soils	2,972	0.5%	0.6%
Total	**527,999**	**84%**	**100%**

Livestock were responsible for the majority of the Agriculture sector's GHG emissions (99%, or 522,711 tCO_2e) (Table 3). Sheep account for 50% of agricultural emissions and 42% of gross emissions in Wairoa. Non-dairy cattle account for 44% of agricultural emissions and 37% of gross emissions in Wairoa.

Table 3 Agriculture emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Sheep	262,139	41.5%	49.6%
Non-dairy Cattle	234,354	37.1%	44.4%
Dairy Cattle	15,941	2.5%	3.0%
Other livestock	10,277	1.6%	1.9%
Fertiliser (other)	5,288	0.8%	1.0%
Total	**527,999**	**84%**	**100%**

3.2 Transport

Transport produced 69,785 tCO_2e in 2020/21 (11% of Wairoa gross total emissions). Table 4 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emission source.

Table 4 Transport energy emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Diesel	47,574	7.5%	68.2%
Petrol	18,018	2.8%	25.8%
Marine Freight	3,911	0.6%	5.6%
Jet Kerosene	131	<0.1%	0.2%
LPG	77	<0.1%	0.1%
Rail	61	<0.1%	0.1%
Aviation Gas	13	<0.1%	<0.1%
Total	**69,785**	**11%**	**100%**

Most of Transport emissions can be attributed to diesel and petrol, which produced 47,574 tCO_2e and 18,018 respectively (collectively 94% of the sector's emissions and 10% of total gross emissions). Diesel and petrol transport emissions are broken down into on-road and off-road use. On-road transport consists of all standard transportation vehicles used on roads (including cars, trucks, buses, etc.). Off-road transport consists of all fuel used for the movement of machinery and vehicles off roads (including agricultural tractors and vehicles, forklifts, etc.). On-road transport produced 56,400 tCO_2e (81% of Transport emissions) and Off-road transport produced 9,269 tCO_2e (13% of Transport emissions). An extra breakdown of on-road emissions by vehicle type and class is provided separate to this report.

The next largest emission source for Wairoa is marine freight, which contributed to 6% of the sectors emissions (3,911 tCO_2e). Marine freight emissions are the result of freight movements to and from the Port of Napier. Emissions from this source have been divided between all territorial authorities in the Hawke's Bay region based on relative population sizes. It is understood that the imports and exports through this port are not exclusively related to activities in the Hawke's Bay region, however, to ensure that these emissions are reflected in community carbon footprints as per the GPC requirements this approach is appropriate.

The remaining transport emissions are attributed to air travel (jet kerosene and aviation gas), rail freight emissions, and LPG use for transport (e.g. forklifts).

3.3 Stationary Energy

Producing 20,662 tCO_2e in 2020/21, Stationary Energy was Wairoa's third highest emitting sector (3% of total gross emissions). Table 5 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emission source.

Table 5 Stationary energy emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Coal	7,111	1.1%	34.4%
Electricity Consumption	6,854	1.1%	33.2%
Stationary Petrol & Diesel Use	5,186	0.8%	25.1%
Electricity Transmission and Distribution Losses	630	0.1%	3.0%
LPG	611	0.1%	3.0%
Biofuel / Wood	271	<0.1%	1.3%
Total:	**20,662**	**3%**	**100%**

The burning of coal is the largest Stationary Energy emission source in Wairoa, emitting 34% of the sector's emissions, and 1% of Wairoa's total gross emissions (7,111 tCO_2e). The industrial sector is the primary consumer of coal in Wairoa.

Electricity consumption was the cause of 33% of Stationary Energy emissions (6,854 tCO_2e), and 1% of Wairoa's total gross emissions (7,483 tCO_2e when including transmission and distribution losses related to the consumption). There is no natural gas supply to the Wairoa geographical region.

Stationary petrol and diesel consumption generated 25% of the sectors emissions (5,186 tCO_2e). Use of LPG, biofuels produced the remaining Stationary Energy emissions.

Stationary Energy demand can also be broken down by fuel type, and by the sector in which it is consumed. Stationary Energy demand is reported for the following sectors: commercial; residential and industrial. However, emissions from petrol and diesel used for Stationary Energy are not able to be broken down by sector.

- Industrial Stationary Energy consumption accounts for 51% of Stationary Energy emissions (10,624 tCO_2e) and 2% of total gross emissions. Industrial Stationary Energy is energy used within all industrial settings (including agriculture, forestry and fishing, mining, food processing, textiles, chemicals, metals, mechanical/electrical equipment and building and construction activities).
- Residential Stationary Energy consumption accounts for 14% of Stationary Energy emissions (2,881 tCO_2e) and 0.5% of total gross emissions. Residential Stationary Energy is energy used in homes (e.g. for heating, lighting, and cooking).
- Commercial Stationary Energy consumption accounts for 10% of Stationary Energy emissions (1,971 tCO_2e) and 0.3% of total gross emissions. Commercial Stationary Energy is energy used in all non-residential and non-industrial settings (e.g. in retail, hospitality, education, and healthcare).
- The remaining 25% of Stationary Energy emissions (5,186 tCO_2e, 0.8% of gross emissions) were produced by diesel and petrol, which were not allocated to the above categories. Stationary Energy uses of diesel and petrol include stationary generators and motors and for heating.

3.4 Waste

Waste originating in Wairoa (solid waste, wastewater and compost) produced 11,385 tCO_2e in 2020/21, which comprises 2% of Wairoa's total gross emissions. Table 6 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emission source.

Note that it is likely that emissions from solid waste have been overestimated here, due to new data provided which was not available at the time of calculation indicating lower emissions from solid waste. A separate calculation of solid waste emissions with the new data using this methodology will be provided to Wairoa District Council separately.

Table 6 Waste emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Waste in open landfill sites	5,392	0.9%	47.4%
Waste in closed landfill sites	4,069	0.6%	35.7%
Wastewater treatment plants	788	0.1%	6.9%
Individual septic tanks	582	0.1%	5.1%
Composting	554	0.1%	4.9%
Total:	**11,385**	**2%**	**100%**

Solid waste produced the bulk of waste emissions (9,461 tCO_2e in 2020/21), making up 83% of total Waste emissions. Solid waste emissions include emissions from open landfills and closed landfills. Open landfill sites contributed 5,392 tCO_2e and emissions from closed landfill sites produced 4,069 tCO_2e in 2020/21. Both open and closed landfills emit landfill (methane) gas from the breakdown of organic materials disposed of in the landfill for many years after waste enters the landfill. Annual emissions from closed landfill sites will decrease over time as no new waste enters these sites.

Wastewater treatment (treatment plants and individual septic tanks) produced 1,370 tCO_2e making up 12% of total Waste emissions. More than half of households in Wairoa are connected to wastewater treatments plants, which produced total emissions of 788 tCO_2e. Households connected to individual septic tanks produced 582 tCO_2e in wastewater emissions. Wastewater treatment tends to be a relatively small emission source compared to solid waste as advanced treatment of wastewater produces low emissions. In contrast, solid waste generates methane gas over many years as organic material enters landfill and emissions depend on the efficiency and scale of landfill gas capture.

Composting accounts for 5% of total waste emissions (554 tCO_2e in 2020/21). Waste diverted from landfill for composting in the Hawke's Bay Region includes horticultural, animal waste products, green waste, bark and sawdust.

3.5 Industrial Processes and Product Use (IPPU)

IPPU in Wairoa produced 2,488 tCO_2e in 2020/21, contributing 0.4% to Wairoa's total gross emissions. This sector includes emissions associated with the consumption of GHGs for refrigerants, foam blowing, fire extinguishers, aerosols, metered dose inhalers and Sulphur Hexafluoride for electrical insulation and equipment production. IPPU emissions do not include energy use for industrial manufacturing, which is included in the relevant Stationary Energy sub-category (e.g. coal, electricity and/or petrol and diesel). These emissions are based on nationally reported IPPU emissions and apportioned based on population due to the difficulty of allocating emissions to particular geographic locations. Addressing IPPU emissions is typically a national policy issue.

There are no known industrial processes (as defined in the GPC requirements) present in Wairoa (e.g. aluminium manufacture).

Table 7 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emission source. The most significant contributor to IPPU emissions is the use of refrigerants which produced 93% of IPPU emissions (2,313 tCO_2e).

Table 7 Industrial processes and product use emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Refrigerants and air conditioning	2,313	0.4%	93.0%
Aerosols	130	<0.1%	5.2%
SF6 - Electrical Equipment	25	<0.1%	1.0%
Foam Blowing	11	<0.1%	0.4%
SF6 - Other	5	<0.1%	0.2%
Fire extinguishers	4	<0.1%	0.2%
Total	**2,488**	**0.4%**	**100.0%**

3.6 Forestry

Planting of native forest (e.g. mānuka and kānuka) and exotic forest (e.g. pine), sequesters (captures) carbon from the atmosphere while the trees are growing to maturity. Harvesting of forest emits emissions via the release of carbon from organic matters and soils following harvesting. When sequestration by forests exceeds emissions from harvesting in a particular year, the extra quantity of carbon sequestered by forest reduces total gross emissions for that year. Conversely when emissions from harvesting exceed the amount of carbon sequestered by native and exotic forests, then total gross emissions will increase.

Sequestration in 2020/21 was 2,431,276 tCO_2e (which was mostly from exotic forestry) while harvesting emissions were 1,457,248 tCO_2e. This meant that Forestry in Wairoa was a net negative source of emissions in 2020/21 (rather than a positive source of emissions, where harvesting exceeds sequestration). Total Forestry emissions in 2020/21 were -974,028 tCO_2e. It is noted that harvesting of exotic forest can be cyclical in nature where some years will have higher sequestration and some years will have higher harvesting emissions determined by age of forests, commercial operators, and the global market.

Table 8 Forestry emissions by emission source (including sequestration)

Sector / Emissions Source	tCO_2e
Total harvest emissions	1,457,248
Native forest sequestration	-353,945
Exotic forest sequestration	-2,077,331
Total	**-974,028**

3.7 Total Gross Emissions by Greenhouse Gas

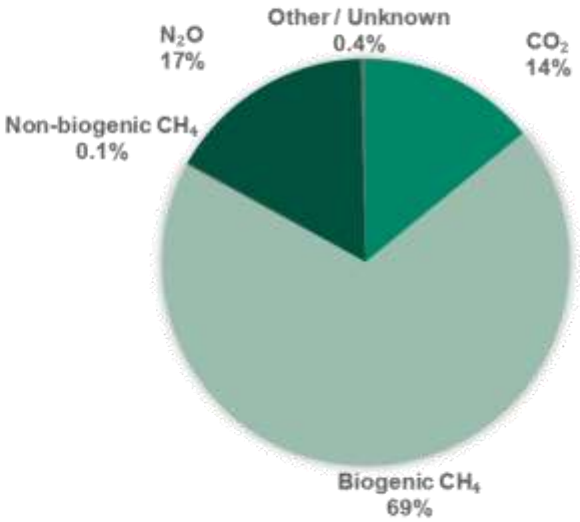
Each greenhouse gas has a different level of impact on climate change, this is accounted for when converting quantities of each gas into units of carbon dioxide equivalent (CO_2e).

Table 9: Wairoa total gross emissions, by greenhouse gas

Greenhouse Gas	Tonnes	Tonnes of CO_2e
Carbon Dioxide (CO_2)	89,010	89,010
Biogenic Methane (CH_4)	12,814	435,667
Non-biogenic Methane (CH_4)	26	868
Nitrous Oxide (N_2O)	351	104,455
Other / Unknown Gas (in CO_2e)	2,320	2,320
Total	**104,519**	**632,319**

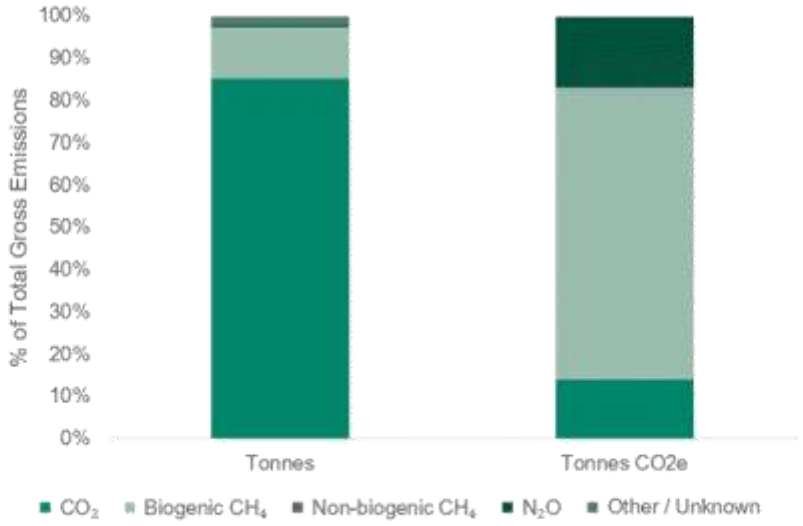
Figure 4 illustrates Wairoa total gross emissions by greenhouse gas in units of carbon dioxide equivalents (CO_2e).

Figure 4: Wairoa District's total gross emissions, by greenhouse gas (in tCO_2e)



By far the largest source of emissions in tonnes is carbon dioxide (CO_2) at 89,010 tonnes. Due to the greater global warming impact of methane, methane represents 12% of the total tonnage of GHG emissions from Wairoa but represents 69% of CO_2e. Nitrous oxide represents 0.3% of the total tonnage of GHG emissions from Wairoa but represents 17% of CO_2e. This effect can be seen in Figure 5.

Figure 5: Wairoa District's total gross emissions, by greenhouse gas in tonnes and in tonnes of CO_2e



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3.8 Biogenic emissions

Biogenic carbon dioxide and methane emissions are stated in Table 10 and Table 11, respectively.

Biogenic CO_2 emissions are those that result from the combustion of biomass materials that store and sequester CO_2, including materials used to make biofuels (e.g. trees, crops, vegetable oils, or animal fats). Biogenic CO_2 emissions from plants and animals are excluded from gross and net emissions as they are part of the natural carbon cycle.

Table 10: Biogenic CO_2 in Wairoa (Excluded from gross emissions)

Biogenic Carbon Dioxide (CO_2) (Excluded from gross emissions)		
Biofuel	8,885	t CO_2
Total Biogenic CO_2	**8,885**	**t CO_2**

Biogenic CH_4 emissions (e.g., produced by farmed cattle via enteric fermentation) are included in gross emissions due to their relatively large impact on global warming relative to biogenic CO_2. Biogenic methane represents 12% of the gross total tonnage of GHG emissions in Wairoa but represents 69% of total gross GHG emissions when expressed in CO_2e. This is caused by the higher global warming impact of methane per tonne, compared to carbon dioxide. The total tonnage of each GHG and the contribution of each GHG to total gross emissions when expressed in CO_2e is shown in Table 9.

The importance of biogenic CH_4 is highlighted in NZ's Climate Change Response (Zero Carbon) Amendment Act. The Act includes specific targets to reduce biogenic CH_4 by between 24% and 47% below 2017 levels by 2050, and by 10% below 2017 levels by 2030. More information on the Act is available here: https://www.mfe.govt.nz/climate-change/zero-carbon-amendment-act.

Table 11: Biogenic Methane in Wairoa (Included in gross emissions)

Biogenic Methane (CH_4) (Included in gross emissions)		
Enteric Fermentation	12,297	t CH4
Landfill Gas	278	t CH4
Manure Management	185	t CH4
Wastewater Treatment	38	t CH4
Composting	9	t CH4
Biofuel	7	t CH4
Total Biogenic CH_4	**12,814**	**t CH4**

3.9 Territorial Authorities in the Hawke's Bay Region

The Hawke's Bay regional area contains several territorial authorities. Hastings District, Napier City, Central Hawkes Bay District, and Wairoa District are all exclusively within the boundaries of the Hawke's Bay region. Additionally, areas of Taupō District and Rangitīkei District are also part of the Hawke's Bay region. We estimate that 0.1% of Taupō's population and 12% of Taupō's area, and 0.3% of Rangitīkei's population and 14% of Rangitīkei's area are within the Hawke's Bay region.

Figure 6 shows the Hawke's Bay's total gross emissions divided by territorial authority. Figure 7 shows total gross emissions for the territorial authorities in the Hawke's Bay Region, split by sector. Both figures only include the emissions produced within the Hawke's Bay region for Taupō and Rangitīkei.

Hastings is the highest emitting territorial authority in the region, representing 43% of the Hawke's Bay's total gross emissions. Hastings' emissions inventory is predominantly agriculture-related emissions with the next largest emitting territorial authorities; Central Hawke's Bay and Wairoa, also containing significant agricultural emissions. Of the four territorial authorities entirely within the Hawke's Bay region, Napier has the lowest total gross emissions, with emissions mostly from Transport and Stationary Energy. The areas of Taupō and Rangitīkei contribute to 2% of the Hawke's Bay region's total gross emissions, almost entirely from Agriculture.

Figure 6 Hawke's Bay's total gross emissions divided by territorial authority (tCO_2e). *Taupō and Rangitīkei totals only include emissions produced in the Hawke's Bay region.

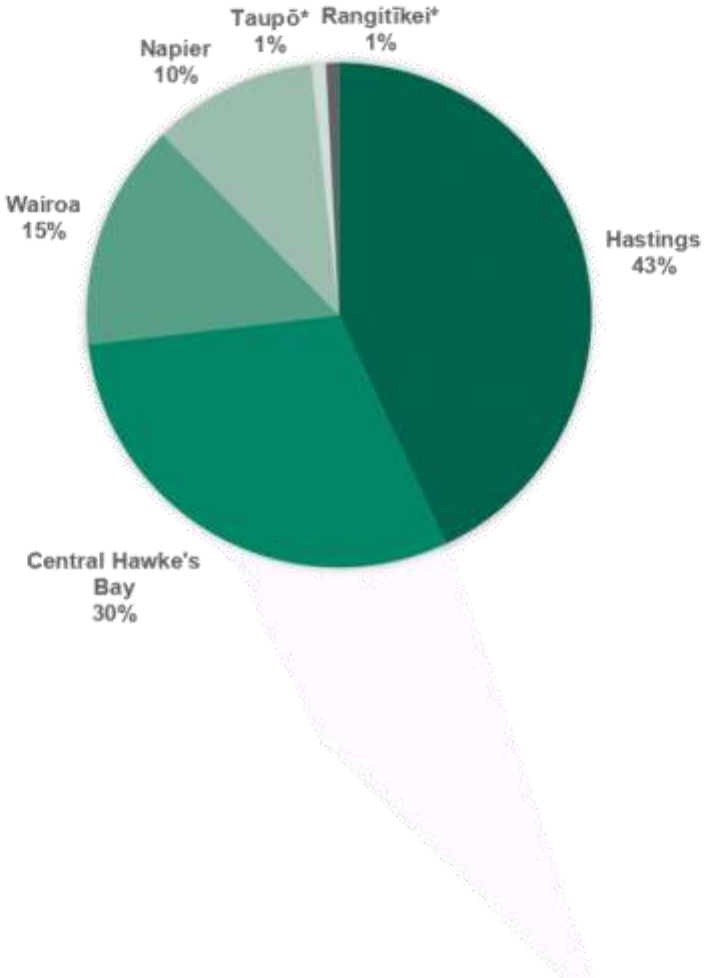
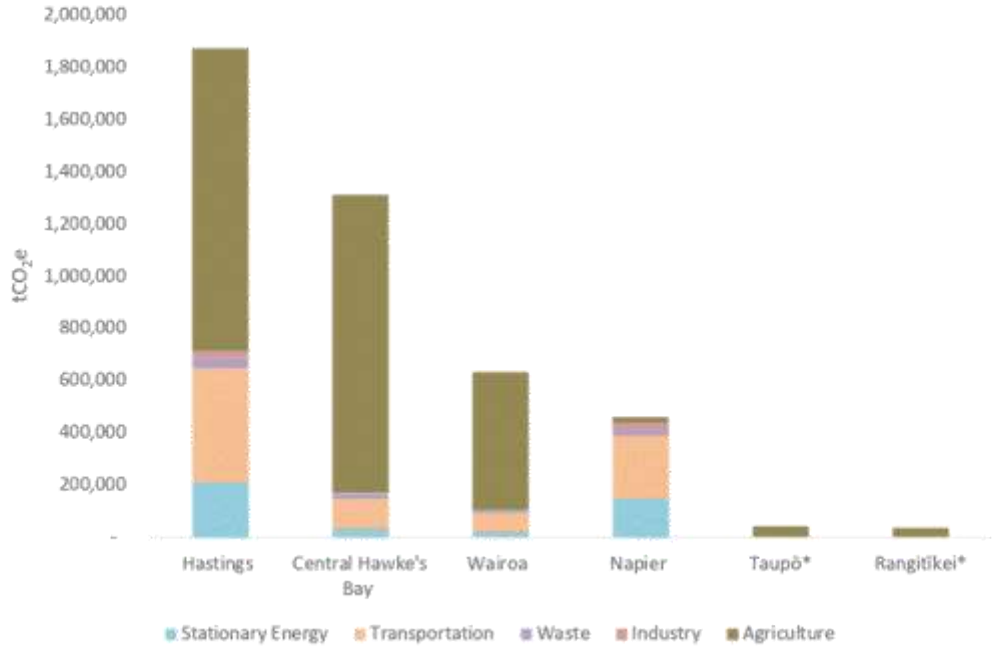


Figure 7 Total gross emissions by territorial authority in the Hawke's Bay region (tCO_2e). *Taupō and Rangitīkei totals only include emissions produced in the Hawke's Bay region.



When comparing emissions inventories from different areas, a per capita figure can be useful because it provides a common reference point to understand the difference in emissions. Figure 8 shows emissions per capita for the region and territorial authorities within the region. Taupō and Rangitīkei are excluded from this figure due to the tiny population and large agriculture within the small area in the Hawke's Bay creating very large per capita emissions (this is not the case for the entire Taupō or Rangitīkei district).

The Hawke's Bay region has a 24.1 tCO_2e/per capita figure for total gross emissions which is higher than the national value of 15.7 tCO_2e/per capita. Notably, Napier has the lowest per capita total emissions at 6.9 tCO_2e/per capita. Central Hawke's Bay and Wairoa have the largest per capita total gross emissions at 84.6 tCO_2e/per capita and 70.3 tCO_2e/per capita respectively, both due to high Agriculture emissions in the district. Hastings has the third highest per capita emissions at 20.9 tCO_2e/per capita, similar to that of the region. Notably, Central Hawke's Bay and Wairoa have very high per capita Agriculture emissions and the highest per capita Transport emissions of the four districts entirely within the Hawke's Bay region.

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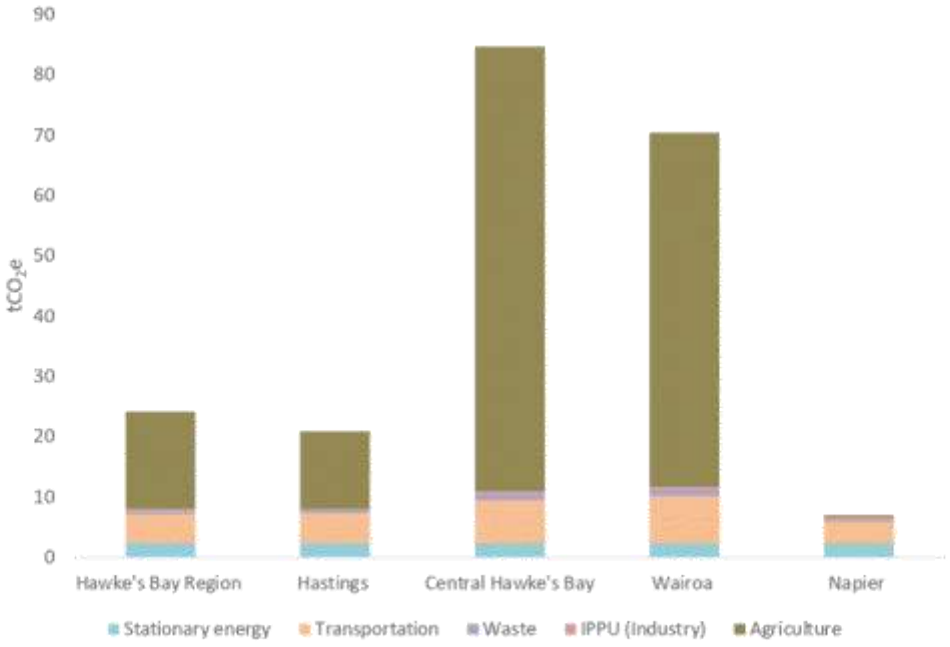
Figure 8 Total gross emissions per capita for the region and territorial authorities within the region (tCO_2e). *Taupō and Rangitīkei areas not included



4.0 Emissions change from 2018/19 to 2020/21

Alongside calculating Wairoa's emissions footprint for 2020/21, we have calculated Wairoa's emissions footprint for 2018/19 and 2019/20. This section displays the results of the 2018/19, 2019/20, and 2020/21 emissions footprints with a focus on Gross emissions and documents the change in emissions from 2018/19 to 2020/21.

An analysis of the impact of the COVID-19 pandemic on Wairoa's emissions is found in Section 6.0. This section is cautious in examining the interpretation of changes, due to the footprint only assessing one financial year (2018/19) prior to the COVID-19 pandemic disruptions.

Table 12 Change in Wairoa total gross and net emissions from 2018/19 to 2020/21

	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Total Net Emissions (including forestry)	-736,431	-452,781	-341,709	54%
Total Gross Emissions (excluding forestry)	672,467	608,018	632,319	-6%

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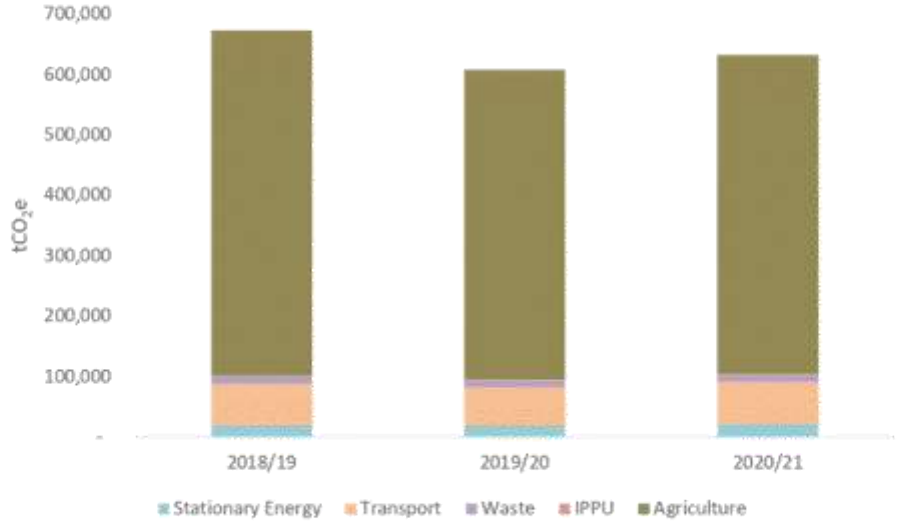
Figure 9 Change in Wairoa total gross emissions from 2018/19 to 2020/21



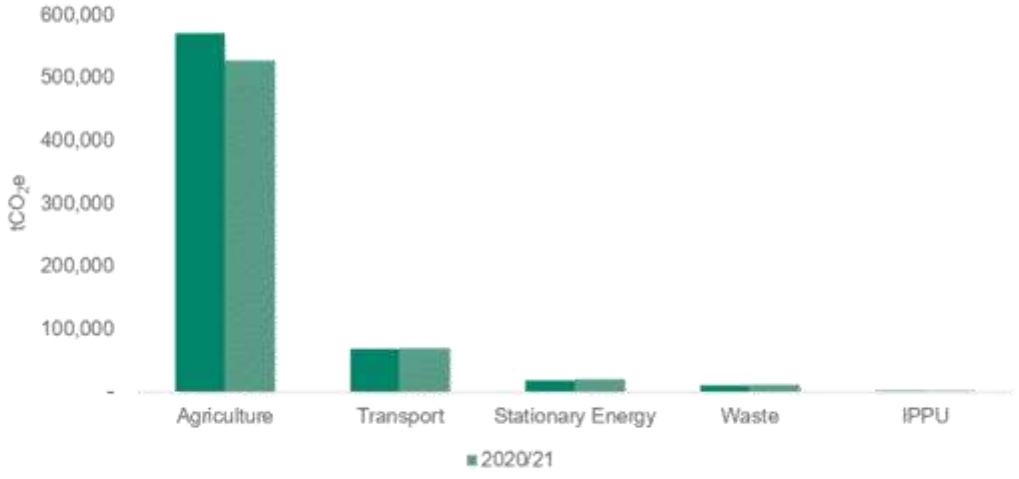
Annual total gross emissions per year decreased by 6% from 672,467 tCO_2e in 2018/19 to 632,319 tCO_2e in 2020/21. This was driven by a decrease in agriculture (number of sheep and non-dairy cattle) and an increase in stationary energy (primarily related to the increase in the emissions intensity of the national electricity grid (tCO_2e/kWh).

Total net emissions in Wairoa increased by 54% from -736,431 in 2018/19 to -341,709 tCO_2e. This increase was predominantly due to an increase in annual forest harvesting emissions. This is discussed further below under the 'Forestry' heading.

Whilst total gross emissions decrease by 6%, the population of Wairoa grew by 3% during this time. This resulted in a 8% decrease in per capita emissions between 2018/19 and 2020/21, from 76.8 to 70.3 tCO_2e per person per year. A discussion of the decoupling of gross emissions from population growth and GDP is found in Section 5.0.

The sections below outline the change in emissions between 2018/19 and 2020/21 for each sector and emissions source, highlighting the changes that have had the largest impact on total gross emissions.

Figure 10 Emissions for each sector of Wairoa gross emissions footprint for 2018/19 and 2020/21



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4.1 Agriculture

Table 13 Change in Wairoa Agriculture emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Enteric Fermentation	451,077	405,217	418,083	-7%
Manure from Grazing Animals	66,138	59,240	61,099	-8%
Other Agriculture Emissions	25,033	22,343	22,693	-9%
Atmospheric Deposition	18,363	16,434	16,878	-8%
Manure Management	6,798	6,145	6,274	-8%
Agricultural Soils	3,913	3,386	2,972	-24%
Total	**571,322**	**512,765**	**527,999**	**-8%**

Agriculture is the most significant contributor to Wairoa community carbon footprint. The sector's emissions decreased by 8% between 2018/19 and 2020/21 (43,323 tCO_2e). This decrease is driven by a reduction in total livestock numbers, especially of sheep and non-dairy cattle (see Table 14).

Emissions related to sheep decreased by 27,395 tCO_2e due to a reduction in the number of sheep (49,979 sheep). Emissions related to non-dairy cattle decreased by 13,163 tCO_2e due to a reduction in the number of non-dairy cattle (6,661 cattle). The number of dairy cattle also reduced, reducing dairy cattle emissions by 1,108 tCO_2e.

Table 14 Change in Wairoa livestock numbers from 2018/19 to 2020/21

	Number of animals (2018/19)	Number of animals (2020/21)	Change in number of animals (2018/19 to 2020/21)
Sheep	528,219	478,240	-49,979
Non-dairy Cattle	98,035	91,374	-6,661
Other livestock	11,643	12,394	751
Dairy Cattle	4,239	3,924	-315
Total livestock	**642,136**	**585,932**	**-56,204**

Table 15 Change in Wairoa's livestock-associated Agriculture emissions from 2018/19 to 2020/21

	2018/19 emissions (tCO_2e)	2020/21 emissions (tCO_2e)	% Change in emissions (2018/19 to 2020/21)
Sheep	289,534	262,139	-9%
Non-dairy Cattle	247,517	234,354	-5%
Dairy Cattle	17,049	15,941	-7%
Other livestock	10,239	10,277	0.4%
Total livestock	**564,339**	**522,711**	**-7%**

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4.2 Transport

Table 16 Change in Wairoa's Transport emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Diesel	46,182	42,175	47,574	3%
Petrol	18,201	16,459	18,018	-1%
Marine Freight	4,578	4,539	3,911	-15%
Jet Kerosene	193	165	131	-32%
LPG	74	74	77	5%
Rail	-	4	61	*N/A*
Aviation Gas	11	13	13	22%
Total:	**69,239**	**63,428**	**69,785**	**1%**

Transport emissions increased by 1% between 2018/19 and 2020/21 (546 tCO_2e). This was driven by a 2% increase in on-road fuel emissions (946 tCO_2e).

It is noted the impact of the COVID-19 pandemic can be seen in Transport emissions where emissions decreased by 8% between 2018/19 and 2019/20 due to reductions in road, marine freight, air transport fuel use. Aviation emissions continued to reduce in the 2020/21 reporting year, reflective of ongoing COVID-19 impacts to the industry.

4.3 Stationary Energy

Table 17 Change in Wairoa Stationary Energy emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Coal	7,166	7,200	7,111	-1%
Stationary Petrol & Diesel Use	5,040	4,601	5,186	3%
Electricity Consumption	4,736	4,923	6,854	45%
LPG	584	586	611	5%
Electricity Transmission and Distribution Losses	414	432	630	52%
Biofuel / Wood	273	272	271	-1%
Total:	**18,212**	**18,013**	**20,662**	**13%**

Emissions from Stationary Energy increased by 13% between 2018/19 and 2020/21 (2,450 tCO_2e). This was driven by a 45% increase in electricity consumption emissions (2,118 tCO_2e). This increase in electricity consumption emissions was due to a 3% increase in energy consumption (kWh) and a 41% increase in the emissions intensity of the national electricity grid (tCO_2e/kWh). The emissions intensity of the national grid has increased in recent years due to the increased use of fossil fuels during years with low hydro electricity generation.

4.4 Waste

Table 18 Change in Wairoa Waste emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Open Landfill	4,623	5,029	5,392	17%
Closed Landfill	4,620	4,333	4,069	-12%
Wastewater treatment plants	747	760	788	5%
Individual septic tanks	636	640	582	-8%
Composting	554	554	554	*NA*
Total	**11,181**	**11,317**	**11,385**	**2%**

Waste emissions increased between 2018/19 and 2020/21, by 2% (204 tCO_2e). Total solid waste in landfill emissions increased by 2% (204 tCO_2e). Emissions from waste in open landfills increased as the volume of waste entering the landfill increased, and waste recently deposited in landfill reaches peak emissions per year (this is after approximately two years in landfill). Emissions from closed landfills decreased due to no extra waste being added, the existing waste in landfill releases fewer emissions over time. Due to data only being available for one singular year, no change in composting emissions is recorded.

Total wastewater emissions remained relatively stable. There was an increase in wastewater treatment plant emissions and a decrease in individual septic tank emissions. This is likely driven by an increase in the number of households connected to centralised wastewater treatment. Better data on the number of households connected to centralized wastewater treatment would improve the accuracy of the emissions calculations.

4.5 Industrial Processes and Product Use (IPPU)

Table 19 Change in Wairoa IPPU emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Refrigerants and air conditioning	2,324	2,315	2,313	-0.5%
Aerosols	146	135	130	-11%
SF6 - Electrical Equipment	23	25	25	10%
Foam Blowing	10	11	11	7%
SF6 - Other	5.0	4.8	4.8	-1%
Fire extinguishers	4.1	4.0	4.0	-2%
Total	**2,512**	**2,495**	**2,488**	**-1%**

IPPU emissions decreased between 2018/19 and 2020/21, by -1% (24 tCO_2e). The decrease in IPPU emissions is mainly caused by a decrease in aerosols. Note that national level data is used for this sector and is portioned out using a population approach; exact emissions for the district are unknown.

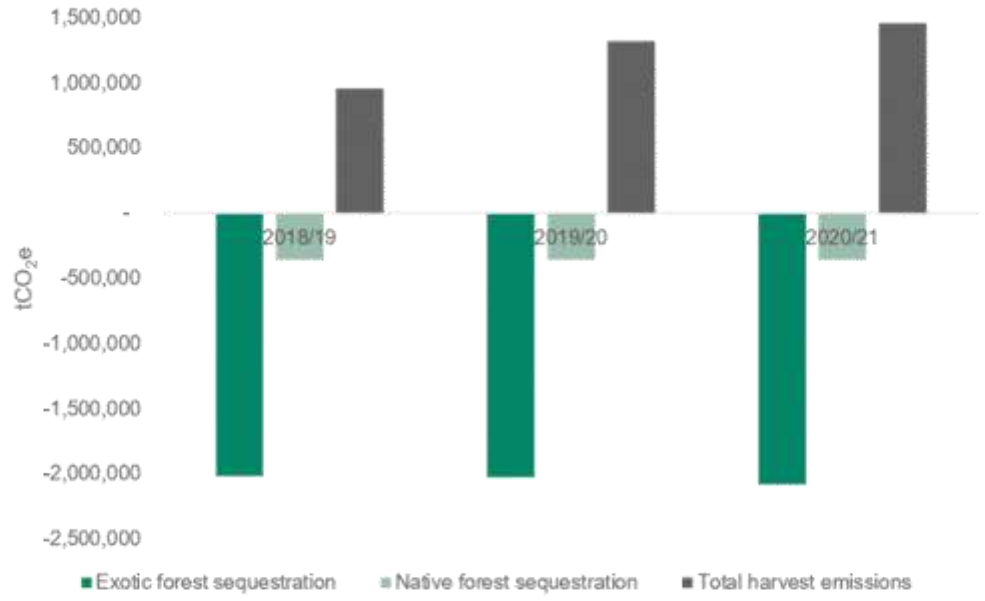
4.6 Forestry

Table 20 Change in Wairoa Forestry emissions from 2018/19 to 2020/21

Sector / Emissions Source	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2018/19 to 2020/21)
Total harvest emissions	957,943	1,317,867	1,457,248	52%
Native forest sequestration	-353,945	-353,945	-353,945	0%
Exotic forest sequestration	-2,012,896	-2,024,721	-2,077,331	3%
Total	**-1,408,899**	**-1,060,799**	**-974,028**	**31%**

Net Forestry emissions changed by 434,871 tCO_2e between 2018/19 and 2020/21 from -1,408,899 tCO_2e to -974,028 tCO_2e. This change was driven by an increase in total harvest emissions (499,306 tCO_2e) as more exotic forest is harvested. Forestry emissions are influenced by the cyclical nature of harvesting and planting regimes where some years will have higher sequestration and some years will have higher harvesting emissions. This is dependent on age of forests and the demand for lumber and timber. Improved and updated data sources may impact the estimation of emissions from this source in the future. Sequestration by native and exotic forest remained relatively stable during this time.

Figure 11 Forestry sequestration and harvesting emissions from 2018/19 to 2020/21



5.0 Decoupling of GHG emissions from population growth and GDP

Figure 12 shows the changes in gross emissions when compared to changes in other metrics of interest between 2018/19 and 2020/21. For example, total gross emissions have decreased by 6%, whilst population in Wairoa has increased by 3%, resulting in an 8% reduction in total gross emissions per capita. Similarly, Gross Domestic Product (GDP) in Wairoa has increased by 1%, resulting in a 7% decrease in the GHG emissions ratio to GDP.

When emissions grow less rapidly than GDP (a measure of income) this process is known as decoupling. The term decoupling is an expression of the desire to mitigate emissions without harming economic wellbeing. A full discussion of decoupling of emissions is beyond the scope of this project. However, the changes in emissions and GDP illustrated in Figure 12 and discussed above, suggest at a high-level decoupling has occurred between 2018/19 and 2020/21.

The exact drivers for the decoupling of emissions from GDP are difficult to pinpoint. New policies, for restructuring the way to meet demand for energy, food, transportation and housing will all contribute. In this case, both direct local actions (e.g. landfill gas reductions) and indirect national trends (e.g. changes to emissions from electricity generation) will have contributed to trends noted.

Figure 12 Change in total gross emissions compared to other metrics of interest

6.0 Impact of the COVID-19 pandemic on GHG Emissions

COVID-19 impacted New Zealand and the entire world during 2020 and 2021; causing widespread government-imposed restrictions on businesses and individuals and huge shifts in behaviors and economic markets. Restrictions in New Zealand relating to COVID-19 began in mid-March 2020 with many personal and business restrictions continuing past the end of 2019/20 and throughout 2020/21.[3]

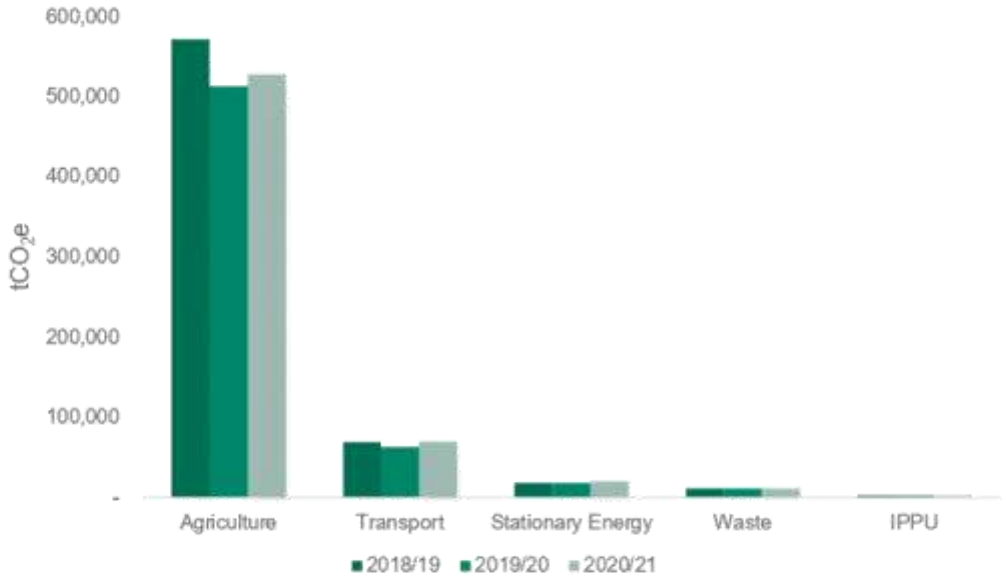
Globally, carbon dioxide emissions from fossil fuels (the largest contributor to greenhouse gas emissions) in 2020 decreased by 7% compared to 2019[4]. Emissions from the transportation sector account for the largest share of this decrease. Surface transport, e.g. car journeys, fell by approximately half at the peak of COVID-19 restrictions in April 2020 (when restrictions were at their maximum, particularly across Europe and the U.S. Globally, emissions recovered to near 2019 levels and are expected to continue to increase.

In New Zealand, national daily carbon dioxide emissions are estimated to have fallen by up to 41% during the level 4 lockdown in April 2020[5]. National gross emissions decreased by 3% from 2018/19 to 2019/20, which was largely driven by a decrease in fuel use in road transport due to COVID-19 pandemic restrictions, a decrease in fuel use in manufacturing industries and construction due to COVID-19 restrictions, and a decrease in fuel use from domestic aviation also due to COVID-19 restrictions.

Total gross emissions in Wairoa decreased by 64,449 tCO_2e (10%) between 2018/19 and 2019/20. Total gross emissions then increased by 24,301 tCO_2e (4%) from 2019/20 to 2020/21.

The impact on emissions in different sectors varied. Notably, Transport emissions reduced by 8% between 2018/19 and 2019/20, driven by reduced road and air transport fuel use. Agriculture emissions reduced between 2018/19 and 2019/20, potentially due to impacts on shipping movements. Despite changes in Stationary Energy, Waste, and IPPU emissions, these sectors are not judged to have been significantly affected by the COVID-19.

Figure 13 Wairau emissions per sector for 2018/19, 2019/20, and 2020/21 (tCO_2e)



[3] https://covid19.govt.nz/alert-system/history-of-the-covid-19-alert-system/
[4] Pierre Friedlingstein et al. - Global Carbon Budget 2020 (2020)
[5] Corinne Le Quere et al. – Temporary Reduction in Daily Global CO_2 Emissions During the COVID-19 Forced Confinement

7.0 Closing Statement

Wairoa GHG emissions footprint provides information for decision-making and action by the council, Wairoa stakeholders, and the wider community. We encourage the council to use the results of this study to update current climate actions plans and set emission reduction targets.

The emissions footprint developed for Wairoa covers emissions produced in the Stationary Energy, Transport, Waste, IPPU, Agriculture, and Forestry sectors using the GPC reporting framework. Sector-level data allows Wairoa to target and work with the sectors that contribute the most emissions to the footprint.

Understanding of the extensive and long-lasting effects of climate change is improving all the time. It is recommended that this emissions footprint be updated regularly (every two or three years) to inform ongoing positive decision making to address climate change issues.

The accuracy of any emissions footprint is limited by the availability, quality, and applicability of data. Areas where data could be improved for future footprints include forestry (forest cover and harvesting), agriculture (especially livestock numbers), wastewater, and on and off-road transport fuel use.

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8.0 Limitations

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Appendix A

Assumptions and Data Sources

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Sector / Category	Assumption and Data Sources
General	
Geographical Boundary	LGNZ local council mapping boundaries have been applied. The emissions footprint for the Hawke's Bay Region covers the entirety of the Hawke's Bay Region (this excludes some of the Rangitikei and Taupō territorial authorities). Emissions footprints for each territorial authority covers the entirety of the territorial authority area.
Population	Population figures are provided by StatsNZ. Financial year populations have been used, these are based on the average population from the two calendar years (e.g. the average of 2018 and 2019 calendar year populations for FY19). The population of Taupo and Rangitikei Districts within the Hawke's Bay geographical boundary has been calculated.
Transport Emissions	
Petrol and Diesel:	Petrol and diesel sales data provided by Napier City Council for Napier, Central Hawkes Bay and Hastings. Combined sales data for Gisborne and Wairoa provided by Gisborne District Council and allocated to a region based on Waka Kotahi emissions data. Sales have been divided between territorial authorities based on the number of kilometres travelled by vehicles on roads (VKT) in each territorial authority. VKT data provided by Waka Kotahi. The division into transport and stationary energy end use (and within transport into on-road and off-road) has been calculated using fuel end use data provided by the Energy Efficiency and Conservation Authority (EECA) from the 2019 database. Biofuel sales information provided directly by the supplier.
Rail Diesel	Emissions from fuel use have been calculated and provided by Kiwi Rail. The following assumptions were made: - Net Weight is product weight only and excludes container tare (the weight of an empty container) - The Net Tonne-Kilometres (NTK) measurement has been used. NTK is the sum of the tonnes carried multiplied by the distance travelled. - National fuel consumption rates have been used to derive litres of fuel for distance. - Type of locomotive engine used, and jurisdiction topography, have not been incorporated in the calculations. The trans-boundary routes were determined, and the number of stops taken along the way derived. The total amount of litres of diesel consumed per route was then split between the departure district, arrival district and any district the freight stopped at along the way. If the freight travelled through but did not stop within a district, no emissions were allocated. This data is subject to commercial confidentiality.
Jet Kerosene (Scheduled Flights) Aviation Gas (General Aviation)	Calculated from information provided by Hawke's Bay Airport. Aviation fuel and jet kerosene fuel volumes were provided and emissions have been calculated using these volumes. Emissions have been divided between territorial authorities based the relative population of each territorial authority.

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Marine Freight	Shipping schedules have been provided by the Port of Napier. Emissions have been calculated based on ship weight and distance from the origin/destination to Napier. This figure does not include fishing vessels, or vessels with destination to be confirmed. Emissions from freight and international shipping are allocated equally between the origin and destination area emissions footprints. It is expected that imports and exports travelling through the Port of Napier service the entire Hawke's Bay Region. Emissions relating to freight and international shipping emissions have been divided between all Hawke's Bay territorial authorities based on population size.
Marine Fuel (Local)	Non-freight marine fuel use has not been included in this study. Fuel use by Port of Napier-controlled vessels has not been included due to a lack of available information. Most private marine vessels use fuel purchased at vehicle fuel stations. Petrol and diesel used in private marine vessels is included in off-road transportation.
LPG Consumption	North Island LPG sales data (tonnes) has been provided by the LPG Association. 'Auto' and 'Forklift' sales represent transport uses of LPG. Sales have been divided between territorial authorities on a per capita basis.
Stationary Energy Emissions	
Electricity Demand	Electricity demand has been calculated using grid exit point (GXP) data from the EMI website (www.emi.ea.govt.nz). Reconciled demand has been used as per EMI's confirmation. The territorial authorities serviced by each GXP have been confirmed by the respective electricity suppliers. The breakdown into sectors (Residential, Commercial, and Industrial) is based on NZ average consumption per sector as per Ministry for the Environment (MfE) data.
Electricity Generation	Electricity generation has been calculated using data from the EMI website (www.emi.ea.govt.nz). Small electricity generation has not been included in this data (e.g. domestic solar generation). This figure only includes electricity that is connected to the national electricity grid, direct users of electricity are not included.
Coal Consumption	National coal consumption data has been provided by MBIE. Regional industrial coal data has been provided by EECA. National residential and commercial coal consumption has been divided between territorial authorities on a per capita basis. Regional industrial coal consumption has been divided between territorial authorities on a per capita basis.
Coal Production and Fugitive Emissions	Not Calculated: There are no active coal mines within the region.
Biofuel Consumption	National biofuel consumption data has been provided by the Ministry for Business, Innovation and Employment (MBIE). Biofuel consumption has been divided between territorial authorities on a per capita basis. Biofuel emissions are broken down into Biogenic emissions (CO_2) and Non-Biogenic emissions (CH_4 and N_2O)

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LPG Consumption	North Island LPG sales data (tonnes) has been provided by the LPG Association. 'Auto' and 'Forklift' sales represent transport uses of LPG. All other sales represent stationary energy uses of LPG. Sales have been divided between territorial authorities on a per capita basis. The breakdown into sectors (Residential, Commercial, and Industrial) is based on NZ average consumption per sector as per MfE data.
Natural Gas Consumption	Natural gas consumption data has been provided by FirstGas. Territorial Authorities supplied by gas from each Point of Connection (POC) have been confirmed by FirstGas. Natural gas consumption has been split into residential, commercial, and industrial consumption based on information provided by PowerCo and national statistics from MBIE. Some POCs supply gas to particular industrial users exclusively, these have been taken into account.
Oil and Gas Fugitive Emissions	Not Calculated: There are no gas or oil processing plants within the region.
Agricultural Emissions	
General	Territorial authority livestock numbers and fertiliser data taken from the Agricultural Census (StatsNZ). The last territorial authority census was in 2017. Regional agricultural data from StatsNZ (2021) has been used to estimate the change in livestock and fertiliser use since 2017. Territorial authority land-use data provided by HBRC covering horticulture land-use.
Solid Waste Emissions	
Waste in Landfill	Landfill waste volume and end location information has been provided by the respective council departments. Where information is not available, waste volumes have been estimated based on historical national data on a per capita basis. Emissions are allocated to territorial authorities based on where the waste was produced, even if the waste is disposed in landfill outside the territorial authority.
Wastewater Emissions	
Wastewater Volume and Treatment Systems	Information on treated wastewater, and treatment plants has been provided by the respective council departments. Where information is not available, reasonable assumptions have been made and the WaterNZ database has been consulted. The population connected to septic tank systems have been estimated by the respective council departments. Where the population covered by Wastewater treatment plants and septic tanks does not account for the entire population, the remaining population is assigned to septic tanks. Emissions are allocated to territorial authorities based on where the wastewater was produced, even if the wastewater is treated outside the territorial authority.
Industrial Emissions	
Industrial processes	It is assumed that there are no significant non-energy related emissions of greenhouse gasses from industrial processes in the Region (e.g. aluminium manufacture).
Industrial Product Use	National data covering industrial product use (e.g. fire extinguishers, refrigerants) has been provided by the MfE. Emissions have been allocated to territorial authorities on a per capita basis.

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Forestry Emissions	
Exotic Forestry Harvested	Harvested forestry, and forest cover information for each territorial authority has been derived from Landcare Research data. It has been assumed that only 70% of the tree is removed as roundwood and that the above ground tree makes up approximately 74% of the total carbon stored.
Exotic Forest	Exotic forest land area for each territorial authority has been provided by Landcare Research.
Emission Factors	
General	All emission factors have detailed source information in the calculation tables within which they are used. Where possible, the most up to date, NZ-specific EFs have been applied. AR5 Global Warming Potential (GWP) figures for greenhouse gases have been used accounting for climate change feedbacks.

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